PTO-1542
(4-85)

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE

MD

ONLINE SEARCH REQUEST FORM

USER G. Stevens SERIAL NUMBER 08/321,603

ART UNIT 2411 PHONE 308- DATE 9/11/96

Please give a detailed statement of requirements. Describe as specifically as possible the subject matter to be searched. Define any terms that may have special meaning. Give examples or relevant citations, authors, or keywords, if known.

You may include a copy of the broadest and or relevant claim(s).

Follow-up -
Focus on scheduling optimization

STAFF USE ONLY

COMPLETED 9/11
SEARCHER Colleen Lytton 308-7793
ONLINE TIME 192 TOTAL TIME 232
(in minutes)
NO. OF DATABASES 7?

SYSTEMS
✓ CAS ONLINE STN
— DARC/QUESTEL
✓ DIALOG
— SDC
✓ OTHER EPOQUE II

```
File 351:DERWENT WPI 1981-1996/UD=9635;UA=9631;UM=9623
         (c)1996 Derwent Info Ltd
File 350:Derwent World Pat. 1963-1980/UD=9632
         (c) 1996 Derwent Info Ltd
File 348:EUROPEAN PATENTS 1978-1996/SEP W1
         (c) 1996 European Patent Office
File 347:JAPIO OCT 1976-1996/Apr.
         (c) JPO & JAPIO
File 344:Chinese Patents ABS Apr 1985-1996/Sep
         (c) 1996 European Patent Office

Set     Items   Description
S1    1183565   PRODUCTION? OR FACTORY OR FACTORIES OR MANUFACTUR? OR SHOP?
              OR ASSEMBLY()LINE? OR ASSEMBLYLINE?
S2        100   (OPTIMIZ? OR OPTIMIS?)(7N)SCHEDUL?
S3        256   LINEAR(2W)PROGRAM?
S4         39   CONSTRAINT?(7N)VIOLAT?
S5          0   S1 AND S2 AND S3 AND S4
S6          1   S1 AND S2 AND S3
S7        173   (OPTIMIZ? OR OPTIMIS?)(S)SCHEDUL?
S8         50   CONSTRAIN?(S)VIOLAT?
S9          0   S1 AND S7 AND S3 AND S8
S10         1   S1 AND S7 AND S3
S11         0   S10 NOT S6
S12        12   (OPTIMIZ? OR OPTIMIS?) AND SCHEDUL? AND CONSTRAIN?
S13         1   S12 AND VIOLAT?
S14         1   S13 NOT S6
S15         1   S12 AND (LOOKAHEAD OR LOOK?()AHEAD OR FORWARD OR BACKWARD -
             OR HEURISTIC? OR ITERAT?)
S16         2   (S14 OR S15) NOT AD=>941012
```

?t 6/7/all

6/7/1 (Item 1 from file: 347)
DIALOG(R)File 347:JAPIO

04969573
QUASI **OPTIMIZATION** METHOD FOR **SCHEDULING** PROBLEM

PUB. NO.: 07-262173 [JP 7262173 A]
PUBLISHED: October 13, 1995 (19951013)
INVENTOR(s): SUZUKI TAKAHIKO
APPLICANT(s): CHICHIBU ONODA CEMENT CORP [000024] (A Japanese Company or Corporation), JP (Japan)
APPL. NO.: 06-090432 [JP 9490432]
FILED: March 24, 1994 (19940324)

ABSTRACT

PURPOSE: To decide a **production** process schedule in a comparatively short time and to find a solution satisfied by a planner i.e., a quasi optimization solution by evading the nonexistence of the solution by performing self adjustment by varying the constraint condition of the **production** process schedule.

CONSTITUTION: For example, in a **manufacturing** system of cement, a cement clinker from a calcining system 1 is stored transiently in an intermediate silo 2, and after it is milled in a milling system 3 with gypsum, cement as a final product is sent out from a product silo 4 to shipping equipment 5. In such a case, a state in which a targeted soultion can be obtained by clearing the constraint condition is generated when unmatching occurs between input data and the constraint condition. Therefore, a penalty constant and a penalty variable to relax the limiting value of a constraint equation are added. In this way, it is possible to set a state to which constraint condition importance should be given depending on the value of the penalty constant, and simultaneously, the solution of a **linear programming** problem is outputted by performing the self adjustment by supplying the excess share of a constraint value as the penalty variable.

?t s16/7/all

16/7/1 (Item 1 from file: 351)
DIALOG(R)File 351:DERWENT WPI

010523173 WPI Acc No: 96-020126/02
XRPX Acc No: N96-016806 *Image available*
Resource allocation optimising **method for plant construction** scheduling - **by storing variable obtained when quadratic objective function cannot be further improved as** optimised **resource allocation**
Patent Assignee: (HITA) HITACHI LTD
Author (Inventor): KOBAYASHI Y; TAKAMOTO M; YAMADA N
Number of Patents: 001
Number of Countries: 001
Patent Family:

CC	Number	Kind	Date	Week	
US	5471408	A	951128	9602	(Basic)

Priority Data (CC No Date): JP 92226465 (920803)
Applications (CC,No,Date): US 92917 (930719)
Abstract (Basic): US 5471408 A

The method involves inputting input data designating available physical resources, the linear allocation **constraints** , a specification of the allocation objects, and an initial state of the each allocation object. The input data are stored in the memory. A variable describing a resource allocation state of the resource allocation **optimization** model to be changed is **iteratively** selected.

A variable of the resource allocation **optimization** model using the variable selected is renewed. Variables obtained when a quadratic objective function cannot be further improved are stored as an **optimized** resource allocation in the memory. A plan for allocating the physical resources to the each allocating objects are visually outputted using the stored **optimized** resource allocation.

ADVANTAGE - Improves efficiency of searching for optimal solution of combinatorial **optimization** problem. Automatically obtain solution of large scale problem. Dwg.2/16

Derwent Class: T01;
Int Pat Class: G06F-017/00

16/7/2 (Item 2 from file: 351)
DIALOG(R)File 351:DERWENT WPI

009756679 WPI Acc No: 94-036530/05
XRAM Acc No: C94-016773
XRPX Acc No: N94-028415
Process model for controlling prodn. plant minimises energy cost - with cost structure of several levels, while meeting product demand in given time, is esp. useful for air sepn. plants
Patent Assignee: (PRAX-) PRAXAIR TECHNOLOGY INC
Author (Inventor): BONAQUIST D P; HANSON T C; JORDAN M D
Number of Patents: 006
Number of Countries: 011
Patent Family:

CC	Number	Kind	Date	Week	
EP	581273	A1	940202	9405	(Basic)
BR	9303028	A	940315	9414	

CA 2101507	A	940130	9416
US 5315521	A	940524	9420
JP 6182192	A	940705	9431
CN 1086009	A	940427	9528

Priority Data (CC No Date): US 921144 (920729)
Applications (CC,No,Date): CN 93116877 (930728); EP 93112088 (930728); BR 933028 (930728); CA 2101507 (930728); JP 93204500 (930728)
Language: English
EP and/or WO Cited Patents: No-SR.Pub
Designated States (Regional): BE; DE; ES; FR; GB; IT

Abstract (Basic): EP 581273 A

A method for producing at least two prods. from a prodn. site to satisfy a given demand for each of the prods. within a fixed time. The prodn. rate is related to energy consumption and varied to minimise the cost of electrical energy where the energy cost structure has multiple levels. A process model is formed for the site which defines a linear or convex relationship between the rate of prodn. of each prod. and the amt. of energy used for its prodn.. The process **constraints** are identified for the site and operating points selected to satisfy the process model within the feasible operation of the process. Operating points are computed as a convex combination of fractions of the operating points in the matrix of discrete operating points with each fraction having a value from zero to one. An objective function is established which will minimise the cost of energy for prod. prodn. for all operating points and a first linear programming model if based on the function so that its soln. will determine the min. energy required to produce the required prods. within a given time. The model is then solved.

A second linear programming model may be constructed and solved independent of the first linear programming model to compute prodn. rates for each energy cost level. The prods. may be selected from liq. and gaseous oxygen, nitrogen and argon produced in an air sepn. plant. Equations are given for the linear programming model and the various **constraints** .

USE/ADVANTAGE - To control a prodn. process, esp. air sepn. and liquefication plant, by **optimising** throughputs and energy usage. The system **optimises** the prodn. **schedule** to meet the required prod. demand at min. energy cost, with a number of cost levels, over a given time. Dwg.0/6

Abstract (US): 9420 US 5315521 A

To produce two or more prods. at a site while minimising electrical power consumption, a process model is formed as a linear or convex relationship between prodn. rate and power consumption, process **constraints** are identified, and operating points are selected which satisfy the model without **violating** the **constraints** .

The points are selected from matrix of points which identify process feasible operating space and any point in the space is computed as a convex combination of fractions of the points, each with a value of 0-1. An objective function is established which minimises energy costs for all feasible points, and a linear programming model is formulated to determine min. energy use rate for any output level.

USE/ADVANTAGE - Used partic. for prodn. of liq. or gaseous oxygen, nitrogen and/or argon. Allows energy costs to be minimised while meeting prodn. requirements.

Dwg.3/6

Derwent Class: E36; J07; Q75; T06; X25;
Int Pat Class: B01J-019/00; F25J-001/00; F25J-003/02; F25J-003/04;
G05B-013/02; G05B-013/04; G06F-015/46
Derwent Registry Numbers: 1738-P; 1779-P

```
File 275:IAC(SM) Computer Database(TM) 1983-1996/Sep 11
         (c) 1996 Info Access Co
File 674:Computer News Fulltext 1989-1996/Sep W1
         (c) 1996 IDG Communications
File  16:IAC PROMT(R) 1972-1996/Sep 11
         (c) 1996 Information Access Co.
File  15:ABI/INFORM(R) 1971-1996/Sep W2
         (c) 1996 UMI
File 148:IAC Trade & Industry Database 1976-1996/Sep 11
         (c) 1996 Info Access Co
File 636:IAC Newsletter DB(TM) 1987-1996/Sep 11
         (c) 1996 Information Access Co.
File 624:McGraw-Hill Publications 1985-1996/Sep 10
         (c) 1996 McGraw-Hill Co. Inc
File   9:Business & Industry(R) Jul 1994-1996/Sep 11
         (c) 1996 Resp. DB Svcs.
File  12:IAC Industry Express (sm) 1995-1996/Sep 11
         (c) 1996 Info. Access Co.
File 746:Time Publications 1985-1996/Sep 09
         (c) 1996 Time Inc.
File  88:IAC BUSINESS A.R.T.S. 1976-1996/Sep
         (c) 1996 Information Access Co.
File  47:Magazine Database(TM) 1959-1996/Sep 11
         (c) 1996 INFORMATION ACCESS CO.
File  75:IAC Management Contents(R) 86-1996/Sep W1
         (c) 1996 Info  Access Co
File 211:IAC NewSearch(TM) 1995-1996Sep
         (c) 1996 Info. Access Co.
File 111:Natl.Newspaper Index(TM) 1979-1996/Sep
         (c) 1996 Information Access Co.
File 610:Business Wire 1986-1996/Sep 11
         (c) 1996 Business Wire
File 611:Reuters 1987-1996/Sep 11
         (c) 1996 Reuters Information Services
File 613:PR Newswire 1987-1996/Sep 11
         (c) 1996 PR Newswire Association Inc
File 635:Business Dateline(R) 1985-1996/Sep W2
         (c) 1996 UMI
File 622:Financial Times Fulltext 1986-
         (c) 1996 FT Information Svcs
File 637:Journal of Commerce 1986-1996/Sep 10
         (c) 1996 Journal of Commerce Inc

Set     Items   Description
S1    6250821   PRODUCTION? OR FACTORY OR FACTORIES OR MANUFACTUR? OR SHOP?
                OR ASSEMBLY()LINE? OR ASSEMBLYLINE?
S2       3958   (OPTIMIZ? OR OPTIMIS?)(7N)SCHEDUL?
S3       7006   LINEAR(2W)PROGRAM?
S4        926   CONSTRAINT?(7N)VIOLAT?
S5          0   S1(S)S2(S)S3(S)S4
S6          0   S1(S)S3(S)(OPTIMIZ? OR OPTIMIS?)(S)SCHEDUL?(S)CONSTRAINT?(-
                S)VIOLAT?
S7        789   S1(S)S2
S8         10   S7(S)S3
S9          0   S7(S)S4
S10        10   RD S8 (unique items)
S11         5   S10 NOT PD=>941011
S12         0   S2(S)S3(S)S4
S13         0   (OPTIMIZ? OR OPTIMIS?)(S)SCHEDUL?(S)S3(S)CONTRAINT?
S14       137   (OPTIMIZ? OR OPTIMIS?)(S)SCHEDUL?(S)S3
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S15          38    S14(S)CONSTRAIN?
S16           5    S15(S)(LOOKAHEAD OR LOOK?()AHEAD OR FORWARD OR BACKWARD OR
                HEURISTIC? OR ITERAT?)
S17           4    S16 NOT PD=>941011
S18           4    S17 NOT S11
```

?t s11/3,k/all

11/3,K/1 (Item 1 from file: 275)
DIALOG(R)File 275:IAC(SM) Computer Database(TM)

01613446 SUPPLIER NUMBER: 14188619 (USE FORMAT 7 OR 9 FOR FULL TEXT)
Constraint programming: a practical solution to complex problems.
Roth, Al
AI Expert, v8, n9, p36(4)
Sept, 1993
ISSN: 0888-3785 LANGUAGE: ENGLISH RECORD TYPE: FULLTEXT; ABSTRACT
WORD COUNT: 2338 LINE COUNT: 00192

... robots, inventory control, and scheduling of maintenance and staff).

For production planners, the ability to express scheduling logic explicitly has clear productivity gains over conventional **linear programming** techniques. Indeed, such scheduling rules and strategies can be very difficult to implement using conventional linear (**optimization** -style) **scheduling** systems. But according to Ilog's Bruno Levy: "The claim for constraints is not that they always do it better than conventional technology but rather...

11/3,K/2 (Item 1 from file: 16)
DIALOG(R)File 16:IAC PROMT(R)

01774006
Computer-aided analysis proves to be a valuable process engineering tool
Pulp & paper process engineers use computer-aided analysis for equip/process performance data

Pulp & Paper September, 1987 p. 67-71
ISSN: 0033-4081

... the performance of individual processes and equipment. Programs are available that simulate pulp and paper processes on a personal computer. Article discusses the use of **linear programming** , **optimizing** process control, **production** planning and **scheduling** , and determination of the economic and equipment feasibility of specific proposed processes.
...

11/3,K/3 (Item 1 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00816755 94-66147
Scheduling transfer champagne production
Hruby, H F; Panton, D M
Omega v21n6 PP: 691-697 Nov 1993
ISSN: 0305-0483 JRNL CODE: POMG
AVAILABILITY: Photocopy available from ABI/INFORM

ABSTRACT: Uncertainties in consumer demand and constraints on the **production** process made the scheduling of tirage champagne difficult at Penfolds, to the extent that their inventories of maturing and finished product stock were much higher than desirable. Time-staged **linear**

programming models were developed to analyze this problem and to develop a technique for smoothing **production** and thereby reducing stock levels. These models, together with a spreadsheet implementation, are discussed. A description is provided of both the usefulness of **linear programming** as a **scheduling** technique and the potential for spreadsheet **optimization** software to provide easy access to these methods. ...

11/3,K/4 (Item 2 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00256243 84-34804
A Dynamic Production Planning and Scheduling Algorithm for Two Products Processed on One Line
Liberatore, Matthew J.
European Journal of Operational Research v17n3 PP: 351-360 Sep 1984
ISSN: 0377-2217 JRNL CODE: EJO
AVAILABILITY: Photocopy available from ABI/INFORM 42124.00

ABSTRACT: A dynamic **production** planning and **scheduling** algorithm is presented to **optimize production** of 2 products that are sequentially processed on a single machine or **production** line. It is assumed that **production** occurs over a fixed time horizon and that machine/line **production** rates are fixed. Inventory levels and **production** -run lengths are restricted. The problem is formulated as a nonlinear binary program. An implicit enumeration strategy is used to develop the algorithm, which is...

... 99% of the cases. Analysis is extended to the generalized multi-product problem with no demand backlogging, and a solution strategy based on mixed-integer **linear programming** is presented. ...

11/3,K/5 (Item 1 from file: 148)
DIALOG(R)File 148:IAC Trade & Industry Database

06766924 SUPPLIER NUMBER: 14779947 (USE FORMAT 7 OR 9 FOR FULL TEXT)
Computer assisted mine scheduling.
Stokes, W.P.C.
Mining Magazine, v169, n5, p266(2)
Nov, 1993
ISSN: 0308-6631 LANGUAGE: ENGLISH RECORD TYPE: FULLTEXT
WORD COUNT: 1732 LINE COUNT: 00137

... to achieve target tonnages - and from where in the mine. An example of this technique is shown in Fig. 2.

3. A stockpile management and **scheduling** system (SMS). This incorporates a **linear programming optimising** option which accepts multiple grade targets with defined tolerances and priority weighting. Stockpiles may be optimised to control the variability of the product within set tolerances. A 'stockpile' may be a physical pad or a notional stockpile, for example a **production** period, a train load or a ship load. Reporting modules are included, and an example is shown in Fig. 3.

4. Currently under development is...
?

?t s18/3,k/all

18/3,K/1 (Item 1 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00351018 87-09852
Resource-Constrained Assignment Scheduling
Mazzola, Joseph B.; Neebe, Alan W.
Operations Research v34n4 PP: 560-572 Jul/Aug 1986
ISSN: 0030-364X JRNL CODE: OPR
AVAILABILITY: Photocopy available from ABI/INFORM 15117.00

ABSTRACT: Many resource-**constrained** assignment **scheduling** problems can be constructed as zero-one assignment problems with side **constraints** (APSC). Unlike the familiar assignment problem of **linear programming**, APSC is NP-complete. A branch-and-bound algorithm is defined for solving APSC to optimality. The algorithm uses a depth-first, polychotomous branching strategy in conjunction with a bounding procedure that utilizes subgradient **optimization**. A **heuristic** procedure also is defined for obtaining approximate solutions to APSC. The **heuristic** employs subgradient **optimization** to guide the search for a good solution as well as to provide a bound on solution quality. Presentation is made of computational experience with both procedures, applied to over 400 test problems. The algorithm is shown to be effective across 3 different classes of resource **constrained** assignment **scheduling** problems. The **heuristic** produces solutions for these problems that are, on average, within 0.8% of optimality. ...

18/3,K/2 (Item 2 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00300829 86-01243
Integrated Days Off and Shift Personnel Scheduling
Bailey, James
Computers & Industrial Engineering v9n4 PP: 395-404 1985
ISSN: 0360-8352 JRNL CODE: CIE
AVAILABILITY: Photocopy available from ABI/INFORM 49045.00

ABSTRACT: Personnel **scheduling** traditionally has been solved at 2 separate but related levels: 1. determination of the days an employee should work, and 2. determination of the time an employee should start each workday. An attempt is made to provide a more robust solution to the integrated personnel **scheduling** problem. The solution is formulated as a decomposable **linear program** with unique properties. The integration permits **constraints** involving hourly fluctuations in demand and fixed workforce size to interact. The aim is to minimize the cost of premium pay plus customer inconvenience due to understaffing. The proposed **linear programming** model is compared with 2 alternative formulations: 1. the one-phase tour **heuristic** of McGinnis et al. (1978), and 2. a modification of the 2-phase **optimization** suggested by Baker (1976) and Field (1983). Compared to the 2 alternatives, the integrated model consistently results in lower cost solutions. ...

18/3,K/3 (Item 1 from file: 148)
DIALOG(R)File 148:IAC Trade & Industry Database

02943295 SUPPLIER NUMBER: 04672070
Resource-constrained assignment scheduling.
Mazzola, Joseph B.; Neebe, Alan W.
Operations Research, v34, n4, p560(13)
July-Aug, 1986
ISSN: 0030-364X LANGUAGE: ENGLISH RECORD TYPE: ABSTRACT

ABSTRACT: Resource-**constrained** assignment **scheduling** problems can often be modeled as 0-1 assignment problems with side **constraints** (APSC), which, unlike the popular **linear programming** assignment problem, is NP-complete. A branch-and-bound algorithm is defined for solving APSCs to optimality, using a depth-first polychotomous branching strategy along with a bounding procedure that uses subgradient **optimization** . A **heuristic** procedure for obtaining approximate solutions to APSCs is also defined that uses subgradient **optimization** to lead the quest for a good solution as well as to provide a bound on solution quality. Computational experience is presented with both procedures that is applied to more than 400 test problems. The algorithm is shown to be effective across three different classes of resource-**constrained** assignment **scheduling** problems.

18/3,K/4 (Item 1 from file: 75)

00104877 SUPPLIER NUMBER: 04672070
Resource-constrained assignment scheduling.
Mazzola, Joseph B.; Neebe, Alan W.
Operations Research, v34, n4, p560(13)
July-Aug, 1986
ISSN: 0030-364X LANGUAGE: English RECORD TYPE: Abstract

ABSTRACT: Resource-**constrained** assignment **scheduling** problems can often be modeled as 0-1 assignment problems with side **constraints** (APSC), which, unlike the popular **linear programming** assignment problem, is NP-complete. A branch-and-bound algorithm is defined for solving APSCs to optimality, using a depth-first polychotomous branching strategy along with a bounding procedure that uses subgradient **optimization** . A **heuristic** procedure for obtaining approximate solutions to APSCs is also defined that uses subgradient **optimization** to lead the quest for a good solution as well as to provide a bound on solution quality. Computational experience is presented with both procedures that is applied to more than 400 test problems. The algorithm is shown to be effective across three different classes of resource-**constrained** assignment **scheduling** problems.

```
File 751:Datapro Software Directory 1996/Jul
         (c) 1996 McGraw-Hill, Inc.
File 752:Datapro Product Specifications 1996/Jul
         (c) 1996 McGraw-Hill, Inc.
File 256:SoftBase:Reviews,Companies&Prods. 95-1996/Jul
         (c)1996 Info.Sources Inc
File 621:IAC New Prod.Annou.(R) 1985-1996/Sep 11
         (c) 1996 Information Access Co
File 237:Buyer`s Guide to Micro Software(SOFT) 1993/Sep
         (c) 1993 ONLINE Inc.
File 278:Microcomput.Software Guide 1996/Aug
         (c) 1996 Reed Reference Publishing

Set     Items   Description
S1     226868   PRODUCTION? OR FACTORY OR FACTORIES OR MANUFACTUR? OR SHOP?
              OR ASSEMBLY()LINE? OR ASSEMBLYLINE?
S2        256   (OPTIMIZ? OR OPTIMIS?)(7N)SCHEDUL?
S3        295   LINEAR(2W)PROGRAM?
S4         11   CONSTRAINT?(7N)VIOLAT?
S5          0   S1(S)S2(S)S3(S)S4
S6          7   (OPTIMIZ? OR OPTIMIS?)(S)SCHEDUL?(S)S3(S)CONSTRAINT?
S7          7   S6 AND S1
S8          0   S7 AND VIOLAT?
S9          3   S7 NOT (PY=>1995 OR RY=>1995 OR PD=>941011)
S10     31903   (LOOKAHEAD OR LOOK???()AHEAD OR FORWARD OR BACKWARD OR HEU-
             RISTIC? OR ITERAT?)
S11         2   S1 AND S10(S)(OPTIMIZ? OR OPTIMIS?)(S)SCHEDUL?(S)S3
S12         1   S11 NOT S9
```

?t s9/9/all

9/9/1 (Item 1 from file: 256)
DIALOG(R)File 256:SoftBase:Reviews,Companies&Prods.

01498165 DOCUMENT TYPE: Product

PRODUCT NAME: IESIP - Improved Exploratory Search Technique for Pure Interger Linear (498165)

COSMIC (084298)
Univ of Georgia 382 E Broad St
Athens, GA 30602-4272 United States
TELEPHONE: (706) 542-3265

RECORD TYPE: Directory

CONTACT: Tim Peacock, Dir

IESIP, an Improved Exploratory Search Technique for Pure Integer **Linear Programming** Problems, addresses the problem of **optimizing** an objective functio of one or more variables subject to a set of confining functions or **constraint** by a method called discrete **optimization** or integer programming. Integer programming is based on a specific form of the general **linear programming** problem in which all variables in the objective function and all variables in the **constraints** are integers. While more difficult, integer programming is required for accuracy when modeling systems with small numbers of components such as the distribution of goods, machine **scheduling** , and **production scheduling** . IESIP establishes a new methodology for solving pure integer programming problems by utilizing a modified version of the univariate exploratory move developed by Robert Hooke and T.A. Jeeves. IESIP also takes some of its technique from the greedy procedure and the idea of unit neighborhoods. A rounding scheme uses the continuous solution found by traditional methods (simplex or other suitable technique) and creates a feasible integer starting point. The Hook and Jeeves exploratory search is modified to accommodate integers and **constraints** and is then employed to determine an optimal integer solution from the feasible starting solution. The user-friendly IESIP allows for rapid solution of problems up to 10 variables in size (limited by DOS allocation). Sample problems compare IESIP solutions with the traditional branch-and-bound approach. IESIP is written in Borland's TURBO Pascal for IBM PC series computers and compatibles running DOS. Source code and an executable are provided. The mai memory requirement for execution is 25K. This program is available on a 5.25 inch 360K MS DOS format diskette. IESIP was developed in 1990.

DESCRIPTORS: Science; Engineering; CAE; Linear Programming; Goal Seeking; Math Packages
HARDWARE: IBM PC & Compatibles
OPERATING SYSTEM: Operating System Independent
PROGRAM LANGUAGES: PASCAL
TYPE OF PRODUCT: Micro
POTENTIAL USERS: Science, Engineering, CAE
DATE OF RELEASE: 01/90
PRICE: $100;, documentation - $24

DOCUMENTATION AVAILABLE: Source code
OTHER REQUIREMENTS: 25K RAM required
REVISION DATE: 950822

9/9/2 (Item 2 from file: 256)
DIALOG(R)File 256:SoftBase:Reviews,Companies&Prods.

01244058 DOCUMENT TYPE: Product

PRODUCT NAME: CPLEX Linear Optimizer 3.0 (244058)

Cplex Optimization Inc (469459)
930 Tahoe Blvd Bldg 802 #279
Incline Village, NV 89451 United States
TELEPHONE: (702) 831-7744

RECORD TYPE: Directory

CONTACT: Todd A Lowe, Pres

CPLEX Linear **Optimizer** 3.0 solves **linear programming** problems. It can be used to guide business decision makers in allocating scarce resources to alternative activities in a way that is best for their enterprise. Typical applications include: (1) operations **optimization** of a process and **manufacturing** facility; (2) financial planning and management; (3) logistics and **scheduling optimization** ; (4) resource allocation and materials utilization; and (5) economic studies and strategic evaluations. There is virtually no limit to the number of variables, **constraint** equations or non-zero matrix elements. The program is particularly adept at handling large and highly degenerate problems. Modern factorization and pricing routines contribute to solution efficiency. Primal, dual, barrier and network algorithm options are available. Sophisticated pre-processing is included.

DESCRIPTORS: Linear Programming; **Production** Control; Econometrics; Math Packages; Corporate Planning

HARDWARE: IBM PC & Compatibles; DEC VAX; Sun; HP; Cray; Silicon Graphics; IBM RS/6000; UNIX; DEC
OPERATING SYSTEM: VMS; PC-DOS; MS-DOS; UNIX; HP-UX; ULTRIX; AIX; OSF/1; Solaris; IRIX; OpenVMS
PROGRAM LANGUAGES: C
TYPE OF PRODUCT: Mainframe; Mini; Micro; Workstation
POTENTIAL USERS: Oil, Manufacturing, Transportation, Banking, Finance, Energy, Defense
DATE OF RELEASE: 2/89
PRICE: $3,000 - $35,000; depends upon CPU; floating licensing available

NUMBER OF INSTALLATIONS: 2000
DOCUMENTATION AVAILABLE: User manuals; tutorials
TRAINING AVAILABLE: Telephone support; technical support
OTHER REQUIREMENTS: PC - 640K, others - 8MB RAM required
SERVICES AVAILABLE: Custom programming; consulting; updates
REVISION DATE: 950112

9/9/3 (Item 1 from file: 621)
DIALOG(R)File 621:IAC New Prod.Annou.(R)

0265939

News Release
DATELINE: Rockville, MD May 1, 1990 WORD COUNT: 485

STSC. Inc.
2115 East Jefferson Street
Rochelle, MD 20852
301-984-5000

Contact: Jill Sacks
(301)984-5133

STSC Releases SAA (TM) -Compliant Finite Capacity Scheduling System

Rockville, MD, May 1, 1990-- STSC, Inc., today announced the release of its new Finite Capacity Scheduling System software, a ManuGistics (TM) product. The Scheduler, a business management tool for process and repetitive manufacturing, was built using IBM (R) 's System Applications Architecture (TM) (SAA (TM)) and Common User Access (CUA) conventions and is designed to run on the IBM PS/2 (R) computer under the OS/2 (R) Extended Edition operating system.

The Scheduler is a full-featured manufacturing scheduling tool that forms the execution end of production planning to complete the MRPII cycle. Developed by STSC in partnership with its clients, the Scheduler offers process and repetitive manufacturers better control of their manufacturing operations, more cost-effective use of resources, fewer coslly schedule changes, improved product sequences and reduced changeover costs, lower inventories and better customer service.

The Scheduler, a menu- and mouse- driven system for long- and short-term scheduling, contains features such as:

bucketless time data; allows scheduling down to the minute
manual overrides
interactive scheduling
what-if simulation
full-color graphics scheduling board
flexible user-defined edits, reviews, reports and graphs
diagnostic tools
interfaces with existing systems.

The emphasis of the product's design is on flexibility and user control.

Rather than using a linear programming "optimization" approach, the Scheduler uses a heuristic approach, taking a set of realistic constraints controlled by the user and utilizing them to develop feasible schedules that meet the company's requirements. Any schedule produced by the computer can be overridden to reflect real-world tradeoffs that the user knows but the computer does not; then the Scheduler displays the effects of the changes made.

STSC markets a tull line of products to Fortune 500 manufacturing firms under the LOGISTICS*PLUS (TM) name. They include demand forecasting, DRPII, master production scheduling, bill of materials, and MRPII products for the IBM mainframe environment. The products are fly integrated, real-time logistics planning systems. STSC offers a full line of services to help companies implement these tools

effectively.

For more information on The Finite Scheduling System or any other members of the STSC family of software solutions, contact STSC, Inc., 2115 East Jefferson Street, Rockville, MD 20852, 301-984-5488, or STSC International, LTD., Windsor, UK 0753- 831451.

STSC has more than 20 years of experience in the computer software and services industry. The company delivers software solutions that enable firms to dramaticaily improve their productivity and competitiveness through the use of leading edge planning and control methods in the manufacturing and distribution operations of corporations worldwide. STSC licenses software through its headquarters in Rockville, Maryland, its sales offices in major U.S. cities, its offices in the UNted Kingdom, and through an international network of dealers and distributors.

COMPANY: STSC
PRODUCT: Engineering, Mfg Software (ex Micro) (7372330)
TRADE NAME: Finite Capacity Scheduling System; ManuGistics; Scheduler
EVENT: Product Design & Development (33)
COUNTRY: Maryland (1324); MD (1324)

?t s12/9

12/9/1 (Item 1 from file: 751)
DIALOG(R)File 751:Datapro Software Directory

00253139 DATAPRO ACCESSION NUMBER: 00253139
PRODUCT NAME: Finite Capacity Scheduling System
VENDOR: Manugistics, Inc.
ADDRESS: 2115 E. Jefferson Street, Rockville, MD, 20852 USA
TELEPHONE: 1 301 984 5000; 1 800 592 0050 FAX: 1 301 984 5094
FUNCTION: **Manufacturing** resource planning.
HARDWARE: IBM PS/2 and compatibles; UNIX workstations
MINIMUM MEMORY REQUIRED: 6M
OPERATING SYSTEM: HP-UX; OS/2; OSF/1; other UNIX
PERIPHERALS: 8512, 8513, or 8514 color display; two-button mouse
SOURCE LANGUAGE: C SOURCE LISTING: not available
PRICING: contact vendor
MAINTENANCE: available
TRAINING: Available
FIRST INSTALLED: 1990
PRODUCT DESCRIPTION: The Finite Capacity Planning System is designed for repetitive and process **manufacturing** . Functions include: Business/Planning; Master **Production Scheduling** , including bucketless and rough cut planning; Bills of Material/Routing, including formulas/recipes; JIT Support; and Capacity Requirements Planning with finite **scheduling** . The system supports full color graphics and troubleshooting. It interfaces with demand forecasting, as well as the DRPII and the MRPII systems. It is also SAA-compatible. The **Scheduler** forms the execution end of **production** planning to complete the MRPII cycle. Rather than using a **linear programming** ``**optimization** '' approach, the **Scheduler** uses a **heuristic** approach, taking a set of realistic constraints controlled by the user and utilizing them to develop feasible **schedules** .
DATAPRO CLASSIFICATION: **Manufacturing** Information and Financial Systems (MS)
RECORD CREATION DATE: 19920125
DATE LAST MODIFIED BY DATAPRO: 19950906

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?  ..hi
File : TDB

SS  Results
 1      5339  PRODUCTION OR FACTORY OR FACTORIES OR MANUFACTUR+
 2         7  (OPTIMIZ+ OR OPTIMIS+) 3D SCHEDUL+
 3        42  (OPTIMIZ+ OR OPTIMIS+) S SCHEDUL+
 4         2  1 P  3
 5        65  (OPTIMIZ+ OR OPTIMIS+) P SCHEDUL+
 6         4  1 P  5
 7        53  LINEAR (1W) PROGRAM+
 8         1  6 P  7

Search statement  9
```

? ..li max 1
1/1 - (C) IBM CORP 1993
AN - NN9504501
TI - Multi-Product Delivery System Optimization Procedure
PUB - IBM Technical Disclosure Bulletin, April 1995, US
VOL - 38
NR - 4
PG - 501 - 504
PD - 1995-04-01
TXT - Disclosed is a novel optimization procedure for solving compound multi- product transportation/routing/scheduling

optimization problems. It can be used for any distribution or delivery system operating a heterogeneous fleet of vehicles from one or several depots. Such distribution systems have to supply multi-product demand in a network of several production and destination points. Uniqueness of the tool lies in integrating the modelling and mutual optimization of a multi-product multi-depot delivery system including transportation, routing, scheduling, time-windows and queuing. The algorithm has been implemented in a package of programs written in Fortran, using the IBM* Optimization
Subroutine Library (OSL). Large scale tests with real data proved it to be effective. Only the concept is described in this disclosure.

Consider a network with nodes representing distribution and/or production centers. Each one of a large number of products circulating in the system is produces at one or several nodes and is demanded at some other nodes. These demand nodes may be the production nodes of some other products. Distribution has to be carried out by a heterogeneous fleet of vehicles with various capacities which are to be routed and scheduled to satisfy demands.

At each node a vehicle must be unloaded and/or loaded with products and requires special processing facilities at the nodes (servers). Servers are available for service only during specified times. There is constraint on the number of vehicles which can be serviced at a node at any one time; any additional vehicle waits in a queue. The primary concern is to supply all the customers with the products they have ordered.

Compound multi-product transportation/routing/scheduling/

optimization problems are difficult to solve efficiently. Proposed
is a system or relaxations and approximations designed to reach a near optimal solution of compound problems and to indicate scale of deviation from the optimum. The optimization tool consists of the
following components:

Route generation block: a preparatory stage which produces feasible vehicle-route combinations using a preliminary screening.

Iterative routing block: based on a partial solution (vehicle-route combinations included in the solution so far) that chooses and adds to the final solution current vehicle-route combination with the best estimated contribution to the overall objective function.

Workload re-allocation block: for the vehicle-route combinations included in the partial solution so far, it re-allocates the work-load among the combinations in an optimal way.

Product Flow block: after obtaining the optimal solution for the workload re-allocation problem, which involves all the trucks; this is a modified solution to take into account that the products can be

carried by an integer number of pallets.
Scheduling block: simulating the processing and queuing processes at the network nodes. The aim is to detect the possible (usually interrelated) conflicts; violation of the time windows, excessive congestion at the nodes and resulting violation of duration constraints.
Conflict resolution block: This block employ a stochastic optimization algorithm for choosing the starting time of the vehicles to minimize conflicts in the system.
Upper bound block: Used here is a linear programming relaxation of the compound model to obtain an upper bound for the objective function. Continuous capacity variables are introduced for every feasible route to relax vehicle availability variables service, and congestion constraints. The difference between the optimization solution and this lower estimate bounds the deviation between the solution and the optimum. The above blocks are chained into an interactive scheme. The objective function is derived from the following two goals: The primary goal is to satisfy the demand. The secondary objective is to minimize the transportation cost. Thus, the objective function, which has to be maximized is a large coefficient multiplied by the total amount of the delivered products minus the total transportation cost. The result is a working plan for the vehicle fleet and for the service facilities at the nodes which includes:

- o route for every vehicle,
- o the types, destination, and the amounts of products to be loaded and unloaded at every node along the route,
- o the schedule for every vehicle,
- o assignments and schedules for the servers.

Routing problems of various types has been extensively studied in recent years, (see 1-3). All of these papers deal with various aspects of the routing / scheduling problem but none of them contains an integrated optimization. The special feature of this solution is that it optimizes a multi-facet system which contains a diversity of topics tied together; multi commodity flows, routing, scheduling, flow-shop sequencing and queue optimization. Presented above is the essence of the optimization engine. We now provide some further details on the model:

Each node consumes and supplies some products. Demand and supply matrices are given with entries being demand/supply of product p at the node i. For every product p a producer-customer connection graphs Gp is introduced. A supplier i and a customer j are connected in this graph if and only if customer j is allowed to receive product p from supplier i.

The fleet of vehicles consists of a given number of vehicles with various capacities. Each vehicle is capable of carrying any combination of the products together as long as the overall volume of the cargo does not exceed its capacity. The matrix of the travelling times Trav(ij) between the nodes is given. There is a number of depots and each vehicle belongs to a certain depot. A vehicle must start its route from its depot and return there at the end of the working shift. Consequently all the routes are cyclic. Naturally

all vehicles, even the same one, can visit the same node more than once. The duration of the working shift is constrained by a given time limit.

At each node along its route the vehicle can be unloaded and/or loaded with products. As a freight processing unit, each node is modelled as a service station with a known number of parallel servers and a common (for this node) FIFO queue without preemption. There exists also a mandatory waiting time tman at each node. During this time the vehicle stays at the node but does not occupy the service facilities. The servers are available for service during specified time windows Wlo(i), Wup(i). Though every server can perform any task, the time windows are dependent on the specific node i and the kind of operations to be fulfilled such as loading, unloading, specific groups of products. The reason is that different pieces of equipment and storage facilities have different working hours and are operated by different teams.

The primary concern is to supply all the customers with the products they have ordered. If an un-supplied demand remains, the delivery of some part of it can be either postponed for the next day or, depending on the nature and the amount of the un-supplied produce, external delivery capacity can be hired. There are certain given priorities among the products, (e.g., perishable products are of very high priority for the same day delivery and returnable boxes for packaging are not). Excessive congestion at the servers must be avoided since under strict shift duration constraints for the vehicles, congestion leads to the waste of delivery capacity.

* Trademark of IBM Corp.

References

(1) B. L. Golden and A. A. Assaad (Editors), "Vehicle Routing: Methods and Studies," North-Holland, (1988).

(2) G. Laporte, Y. Nobert and S. Taiplefer, "Solving a family of multi-depot vehicle routing and location routing problems," Trans Sci. 22, 161-172, (1988).

(3) W. Powell and Y. Sheffi, "Design and implementation of an interactive optimisation system for network design in the motor carrier industry," Oper. Res 37, 12-29, (1989).

Search statement 9

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=> d his

     (FILE 'HOME' ENTERED AT 14:33:46 ON 11 SEP 96)

     FILE 'COMPUAB, COMPUSCIENCE, ELCOM, INFODATA, MATH, SOLIDSTATE'
     ENTERED AT 14:34:31 ON 11 SEP 96
L1         18410 FILE COMPUAB
L2          8479 FILE COMPUSCIENCE
L3          7660 FILE ELCOM
L4          2720 FILE INFODATA
L5          8097 FILE MATH
L6          5499 FILE SOLIDSTATE
     TOTAL FOR ALL FILES
L7         50865 S PRODUCTION? OR FACTORY OR FACTORIES OR MANUFACTUR? OR S
L8           218 FILE COMPUAB
L9           148 FILE COMPUSCIENCE
L10           43 FILE ELCOM
L11            4 FILE INFODATA
L12          151 FILE MATH
L13           12 FILE SOLIDSTATE
     TOTAL FOR ALL FILES
L14          576 S (OPTIMIZ? OR OPTIMIS?)(7A)SCHEDUL?
L15         3159 FILE COMPUAB
L16         4520 FILE COMPUSCIENCE
L17          340 FILE ELCOM
L18           27 FILE INFODATA
L19         9619 FILE MATH
L20           54 FILE SOLIDSTATE
     TOTAL FOR ALL FILES
L21        17719 S LINEAR(2W)PROGRAM?
L22          129 FILE COMPUAB
L23           98 FILE COMPUSCIENCE
L24           27 FILE ELCOM
L25            6 FILE INFODATA
L26          113 FILE MATH
L27            7 FILE SOLIDSTATE
     TOTAL FOR ALL FILES
L28          380 S CONSTRAIN?(7A)VIOLAT?
L29            1 FILE COMPUAB
L30            2 FILE COMPUSCIENCE
L31            0 FILE ELCOM
L32            0 FILE INFODATA
L33            1 FILE MATH
L34            0 FILE SOLIDSTATE
     TOTAL FOR ALL FILES
L35            4 S L7 AND L14 AND L21 AND L28
L36            2 DUPLICATE REMOVE L35 (2 DUPLICATES REMOVED)
L37            1 FILE COMPUAB
L38            2 FILE COMPUSCIENCE
L39            0 FILE ELCOM
L40            0 FILE INFODATA
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L41             1 FILE MATH
L42             0 FILE SOLIDSTATE
      TOTAL FOR ALL FILES
L43             4 S L14 AND L21 AND CONSTRAIN? AND VIOLAT?
L44             0 FILE COMPUAB
L45             0 FILE COMPUSCIENCE
L46             0 FILE ELCOM
L47             0 FILE INFODATA
L48             0 FILE MATH
L49             0 FILE SOLIDSTATE
      TOTAL FOR ALL FILES
L50             0 S L43 NOT L35
L51             0 FILE COMPUAB
L52             0 FILE COMPUSCIENCE
L53             0 FILE ELCOM
L54             0 FILE INFODATA
L55             1 FILE MATH
L56             0 FILE SOLIDSTATE
      TOTAL FOR ALL FILES
L57             1 S L14 AND L21 AND CONSTRAIN? AND (LOOKAHEAD OR LOOK?(W)AH
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=> d all 1-2

L36 ANSWER 1 OF 2 COMPUSCIENCE COPYRIGHT 1996 FIZ KARLSRUHE
DUPLICATE 1
AN 95(3):MA13350 COMPUSCIENCE
TI The single-item discrete lotsizing and scheduling problem: Optimization by linear and dynamic programming.
AU Van Hoesel, Stan; Kuik, Roelof; Salomon, Marc; Van Wassenhove, Luk N. (Hoesel, S. van; Wassenhove, L. N. van)
SO Discrete Appl. Math. (1994) v. 48(3) p. 289-303. 1994.
DT Journal
TC Theoretical
CY Germany, Federal Republic of
LA English
IP FIZKA
DN 793.90018
AB This paper considers the single-item discrete lotsizing and scheduling problem (DLSP). DLSP is the problem of determining a minimal cost production schedule, that satisfies demand without backlogging and does not violate capacity constraints. We formulate DLSP as an integer programming problem and present two solution procedures. par The first procedure is based on a reformulation of DLSP as a linear programming assignment problem, with additional restrictions to reflect the specific (setup) cost structure. For this linear programming (LP) formulation it is shown that, under certain conditions on the objective, the solution is all integer. The second procedure is based on dynamic programming (DP). Under certain conditions on the objective function, the DP algorithm can be made to run very fast by using special properties of optimal solutions. (Summary)
CC *I.2.8 Problem solving, control methods and search
F.2.2 Nonnumerical algorithms and problems
ST lotsizing; single-item discrete lotsizing.

L36 ANSWER 2 OF 2 COMPUAB COPYRIGHT 1996 CSA DUPLICATE 2
AN 91:9446 COMPUAB
TI A goal programming network for mixed integer linear programming: A case study for the job-shop scheduling problem.
AU Van Hulle, M.M.
CS Lab. Neuro-en Psychofysiol., Katholieke Univ. Leuven Campus Gasthuisberg, Herestraat, B-3000 Leuven, Belgium
SO INT. J. NEURAL SYST., (1991) vol. 2, no. 3, pp. 201-209.
DT Journal
FS C
LA English
SL English
AB Job-shop scheduling is an np-complete optimization problem subject to precedence and resource constraints. Recently, Foo and Takefuji have introduced a

network-based solution procedure for solving job-shop problems formulated as mixed integer linear programming problems. To obtain the solution, the Tank and Hopfield linear programming network was repeatedly used. However, since such a network frequently produces constraint-violating solutions, the reliability of Foo and Takefuji's approach is doubtful. In this article, it is shown that reliability of the network approach can be greatly improved, by guaranteeing constraint-satisfying solutions, if the original job-shop problem is reformulated as a goal programming problem, before it is mapped onto a goal programming network.

CC CM7. DYNAMIC PROGRAMMING; CA2. NEURAL NETWORKS

UT integer programming; optimization; reliability; production scheduling; neural networks; allocation; goal programming

=> d l57 bib

L57 ANSWER 1 OF 1 MATH COPYRIGHT 1996 FIZ KARLSRUHE
AN 797.60079 MATH
TI Optimization of multiclass queueing networks: Polyhedral and nonlinear characterizations of achievable performance.
AU Bertsimas, Dimitris; Paschalidis, Ioannis Ch.; Tsitsiklis, John N.
SO Ann. Appl. Probab. 4, No. 1, 43-75 (1994).
DT Journal
LA English

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=> d hist
     (FILE 'USPAT' ENTERED AT 12:58:45 ON 09 SEP 96)
                SET PLURAL ON
L1          1415 S (PRODUCTION OR MANUFACTUR? OR SHOP?) (10A) (SCHEDUL?)
L2           498 S (L1 AND OPTIM?)
L3            98 S (L2 AND (RANK? OR ORDER? OR SCOR? OR SORT?) (10A) (SCHED
UL?
L4            82 S (L2 AND (RANK? OR ORDER? OR SCOR? OR SORT?) (5A) (SCHEDU
L?)
L5            31 S (L4 AND (CONSTRAIN?))
L6            16 S (L2 AND (RANK? OR SCOR? OR SORT?) (10A) (SCHEDUL?))
L7            10 S (L2 AND (RANK? OR SCOR? OR SORT?) (5A) (SCHEDUL?))
L8             7 S (L7 AND (CONSTRAIN?))
=>
```

1. Production, Factory, Manufacturing, and Scheduling
2. Optimize, Scheduling (OPTIMIZ? (10A) Schedul)
3. Linear (1W) Programming
4. → Constraints (7A) Violation
5. How to repair Constraints + the Reasons

1. 5,432,887, Jul. 11, 1995, Neural network system and method for factory floor scheduling; Fook C. Khaw, 395/11, 22, 23 [IMAGE AVAILABLE]

2. 5,319,781, Jun. 7, 1994, Generation of schedules using a genetic procedure; Gilbert P. Syswerda, 395/650; 364/281.3, 281.8, DIG.1 [IMAGE AVAILABLE]

3. 5,241,465, Aug. 31, 1993, Method for determining **optimum** schedule in computer-aided scheduling system; Michiko Oba, et al., 364/401R, 402, 408 [IMAGE AVAILABLE]

4. 5,202,987, Apr. 13, 1993, High flow-rate synchronizer/scheduler apparatus and method for multiprocessors; Nimrod Bayer, et al., 395/650; 364/228.3, 230.3, 271.3, 281.8, DIG.1 [IMAGE AVAILABLE]

5. 5,148,370, Sep. 15, 1992, Expert system and method for batch **production** **scheduling** and planning; Maria Litt, et al., 364/468.1, 401R; 395/904, 906, 926 [IMAGE AVAILABLE]

6. 5,040,123, Aug. 13, 1991, Expert system scheduler; Karon A. Barber, et al., 364/468.06, 149, 401R; 395/904, 926 [IMAGE AVAILABLE]

7. 4,796,194, Jan. 3, 1989, Real world modeling and control process; Robert W. Atherton, 364/468.09, 149, 156, 578 [IMAGE AVAILABLE]
=>

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COMMERCIAL DATABASE SEARCH FOR 08/321,603
DIALOG, STN

Prepared for: George Stevens, 2411

By : Ellen Lytton, EIC/CPAC 308-7793

Date : September 10, 1996

George:

Attached you will find the search on material requirement planning that you requested. The results were very light in the patent and software files, and very large in the technical files. With the technical files I found 940 references, and therefore, I added the concept of rank/score which brought the numbers down rather drastically. If you would like the search in the technical files modified or refocused in any way, please call me (308-7793) or put in a search request with my name on it which ever is easier for you. I have saved the original search.

Ellen

PS. I want to run your search across the IBM Technical Disclosure Bulletins, however, the EPOQUE II system goes down at mid-day. I will run the search across the TDBs tomorrow morning first thing (9/11).

```
File 351:DERWENT WPI 1981-1996/UD=9635;UA=9631;UM=9623
         (c)1996 Derwent Info Ltd
File 350:Derwent World Pat. 1963-1980/UD=9632
         (c) 1996 Derwent Info Ltd
File 348:EUROPEAN PATENTS 1978-1996/SEP W1
         (c) 1996 European Patent Office
File 347:JAPIO OCT 1976-1996/Apr.
         (c) JPO & JAPIO
File 344:Chinese Patents ABS Apr 1985-1996/Aug
         (c) 1996 European Patent Office

Set     Items   Description
S1        817   (MATERIAL?(1W)REQUIREMENT? OR CAPACIT?()RESOURCE? OR FINIT-
              E()CAPACIT? OR PRODUCTION)(2N)(SCHEDUL? OR PLANNING) OR LINEA-
              R(1W)PROGRAM?
S2      13722   CONSTRAIN?
S3         45   (LOOKAHEAD OR LOOK?()AHEAD OR HEURISTIC? OR ITERAT?)(5N)(R-
              EPAIR? OR RELAX? OR FIX???)
S4          0   S1 AND S2 AND S3
S5         51   S1 AND S2
S6        287   (LOOKAHEAD OR LOOK?()AHEAD OR HEURISTIC? OR ITERAT?) AND (-
              REPAIR? OR RELAX? OR FIX???)
S7          1   S5 AND S6
S8          1   (S1 OR SCHEDULING OR PLANNING) AND S2 AND S6
S9          0   S7 NOT S8
S10         3   (S1 OR SCHEDULING OR PLANNING) AND S6
S11         2   S10 NOT S8
S12         2   S11 NOT AD=>941012
S13         0   AU=ZWEBEN M? AND AU=DEALE M?
S14     79150   IC=G05B
S15         2   S14 AND S2 AND S6
S16         1   S15 NOT (S8 OR S10)
S17         1   (S1 OR SCHEDULING OR PLANNING OR MRP OR CRP OR FCS) AND S2
              AND S6
S18         0   S17 NOT (S7 OR S12 OR S16)
```

?t /9/1

7/9/1 (Item 1 from file: 348)
DIALOG(R)File 348:EUROPEAN PATENTS

00434215
Dynamic scheduling.
PATENT ASSIGNEE:
International Business Machines Corporation, (200120), Old Orchard Road, Armonk, N.Y. 10504, (US), (applicant designated states: DE;FR;GB)
AUTHOR (Inventor):
Damian, Richard Gus, 870 College Avenue, Palo Alto, CA 94306, (US)
Shah, Manesh Jagmohan, 1788 Frobisher Way, San Jose, CA 95124, (US)
LEGAL REPRESENTATIVE:
Bailey, Geoffrey Alan (27921), IBM United Kingdom Limited Intellectual Property Department Hursley Park, Winchester Hampshire SO21 2JN, (GB)
PATENT (CC, No, Kind, Date): EP 420476 A2 910403 (Basic)
EP 420476 A3 910911
APPLICATION (CC, No, Date): EP 90310204 900918;
PRIORITY DATA (CC, No, Date): US 413412 890927
LANGUAGE (Publication,Procedural,Application): English; English; English
DESIGNATED STATES: DE; FR; GB
INTL PAT CLASS: G05B-019/417;
CITED PATENTS (EP A): EP 332711 A
CITED REFERENCES (EP A)
ROBOTICS AND COMPUTER INTEGRATED MANUFACTURING. vol. 3, no. 2, 1987, ELMSFORD,NY,USA pages 229 - 233; B.Sauve et al: "An expert system for scheduling in a flexible manufacturing system"
JOURNAL OF MANUFACTURING SYSTEMS. vol. 7, no. 1, 1988, DEARBORN,MICHIGAN,USA pages 33 - 45; R.Choi et al: "Evaluation of traditional work scheduling rules in a flexible manufacturing system with a physical simulator"
EXPERT SYSTEMS. vol. 5, no. 3, 1988, Oxford GB pages 198 - 214; J.K.Lee et al: "PAMS: A domain specific knowledge based parallel machine scheduling system";
WORD COUNT: 132

ABSTRACT: EP 420476 A2
This invention provides a new **production scheduling** system. The system includes a technique that utilizes a knowledge base system to dynamically **schedule production** of parts on a plurality of manufacturing machines. The schedule is updated dynamically to conserve synergism with the changing environment. The schedule is created to conform with predefined rules to conserve **constraints** imposed by the machinery to create parts of different specifications. The rules may be hard in that they may be specifiable in mathematical terms or they may be **heuristic** and soft in that they may be allowed to be **relaxed** as determined by operators who have learned from experience with the production machinery. Finally, the invention allows interactive monitoring and adjustment of the schedule by an operator including selective seeding of the schedule.

LEGAL STATUS (Type, Pub Date, Kind, Text):
Application: 910403 A2 Published application (A1withSR;A2withoutSR)
Examination: 910403 A2 Date of filing of request for examination: 901213
Search Report: 910911 A3 Separate publication of the European or International search report
Examination: 930922 A2 Date of despatch of first examination report: 930809

?t s12/7/all

12/7/1 (Item 1 from file: 351)
DIALOG(R)File 351:DERWENT WPI

009838011 WPI Acc No: 94-117867/14
XRPX Acc No: N94-092369 *Image available*
Process modelling and project planning - defining activity and alternative resources required to commence activity, and varying duration of activity based on availability of alternative resources
Patent Assignee: (IBMC) INT BUSINESS MACHINES CORP
Author (Inventor): VALKO A G
Number of Patents: 001
Number of Countries: 001
Patent Family:

CC	Number	Kind	Date	Week	
US	5303170	A	940412	9414	(Basic)

Priority Data (CC No Date): US 862905 (920403)
Abstract (Basic): US 5303170 A
Each activity of a network of activities is performed over a **fixed** or variable period of time. Each current activity comprises selecting a successor activity or activities of the current activity among a number (N) activities in the network as next activity or activities to be performed.
For the current activity is input conditions for starting or finishing M of N successor activities in the network in which the N successor activities are in relation to the current activity. Each condition for starting or finishing a successor activity is specified as a connection of the current activity to the successor activity.
ADVANTAGE - Enables flexible handling of time, **iteration** and resource type as variables.
Dwg.2/9
Derwent Class: T01;
Int Pat Class: G06G-007/48

12/7/2 (Item 2 from file: 351)
DIALOG(R)File 351:DERWENT WPI

008541549 WPI Acc No: 91-045612/07
XRPX Acc No: N91-035547 *Image available*
Multi-function radar with electronic phase-controlled antenna - uses radar management device coupled to radar control in radar measuring device
Patent Assignee: (SIEI) SIEMENS AG
Author (Inventor): FICHTNER J
Number of Patents: 009
Number of Countries: 007
Patent Family:

CC	Number	Kind	Date	Week	
EP	412441	A	910213	9107	(Basic)
DE	3926197	A	910214	9108	
DE	3926198	A	910214	9108	
DE	3926215	A	910214	9108	
DE	3926216	A	910214	9108	
US	5001490	A	910319	9114	
EP	412441	A3	920311	9326	

EP 412441 B1 950111 9506
DE 59008231 G 950223 9513

Priority Data (CC No Date): DE 3926197 (890808); DE 3926198 (890808); DE 3926215 (890808); DE 3926216 (890808)

Applications (CC,No,Date): DE 508231 (900802); EP 90114878 (900802); EP 90114878 (900802); US 562683 (900803); EP 90114878 (900802); EP 90114878 (900802)

Language: German

EP and/or WO Cited Patents: NoSR.Pub; 4.Jnl.Ref; EP 140597 A; 04Jnl.Ref

Designated States (Regional): BE; DE; FR; GB; IT; NL

Filing Details: DE59008231 Based on EP 412441

Abstract (Basic): EP 412441

The multi-function radar allows target location and initiation of target tracking for different category targets, with detection of clutter etc. The radar measuring device incorporates the antenna, the transmitter and receiver, the signal generator and signal processor and the radar control, the latter coupled to a radar management device for ensuring the optimum target search via a number of different radar cones.

Pref. the scanning period and the scanning range are optimised for each radar cone using defined functions in terms of the target velocity and the noise signal power level.

ADVANTAGE - Optimisation of each radar function. @(21pp Dwg.No.1/7)@

Abstract (US): 9114 US 5001490

An optimisation of the monitoring range is achieved for an antenna lobe position for the searth function in a multi-function radar given a prescribed power part, as a result whereof the most beneficial signal shape, the most beneficial form of signal processing and the most beneficial sampling period are also supplied. In that case in which no clutter and no shadowings are present in the monitoring area to be covered by the multi-function radar, an instruction for optimum distribution of the radar power available for the search onto a number of antenna lobes is established.

For general cases, an instruction for optimum distribution of the power available for the search into a number of antenna lobes is established, namely by optimisation of the prescribed cost-benefit function with the assistance of an **iteration** method sequencing in the clock of the generation of elementary radar requests. For general cases, a possibility for generating a radar search request and for parallel up-dating of the **planning** for following search requests is also set forth.

ADVANTAGE - Improved accuracy. @(16pp

Abstract (EP): 9506 EP 412441 B

Multifunction radar having a radar measuring system comprising an electronically phase-controlled antenna, a signal generator, a transmitter, a receiver, a reception signal processing device and a radar control device, having a target tracking device and having a radar management assembly, which progressively establishes inter alia the antenna lobe position, the sampling period, the signal shape and the form of signal processing, and, with respect to this, feeds instructions as elementary radar requests to the radar measuring system, whereby at each instant the radar power available in the radar measuring system is optimally utilised in the search, characterised in that in the basic case, i.e., in the presence neither of clutter nor of shadowings, for the optimisation of the power utilisation of the power component P predetermined for the search, in an antenna lobe, an optimal sampling period and an optimal monitoring range are provided, in which VR is the radial velocity of an object to be detected which is

flying towards the radar, c' is a constant dependent upon the object to be detected in the **fixed** radar parameters, N is the noise power density, Rd = c' (TB/N)1/4 is the individual detection range and TB is the overall duration of the signal shape.

Dwg.1/7

Abstract (DE): DE 3926216

The multi-function radar allows target location and initiation of target tracking for different category targets, with detection of clutter etc. The radar measuring device incorporates the antenna, the transmitter and receiver, the signal generator and signal processor and the radar control, the latter coupled to a radar management device for ensuring the optimium target search via a number of different radar ones.

Pref. the scanning period and the scanning range are optimised for each radar are using defined functions in terms of the target velocity and the noise signal power loud.

ADVANTAGE - Optimsation of each radar function. @(8pp)@

Derwent Class: W06; R19;

Int Pat Class: G01S-007/28; G01S-013/66; G01S-013/72

?t s16/7

16/7/1 (Item 1 from file: 351)
DIALOG(R)File 351:DERWENT WPI

004492208 WPI Acc No: 85-319086/51
XRPX Acc No: N85-237113

Selecting and implementing cutting conditions in machining workpiece by determining ratio of cutting depth and value for feed for comparison with values of preset constraints ; **ITERATIVE**

Patent Assignee: (GENE) GENERAL ELECTRIC CO
Author (Inventor): KOMANDURI R; CARDER C R

Number of Patents: 005
Patent Family:

CC	Number	Kind	Date	Week	
GB	2160335	A	851218	8551	(Basic)
DE	3521165	A	851219	8601	
US	4584649	A	860422	8619	
GB	2160335	B	880727	8830	
IT	1185029	B	871028	9042	

Priority Data (CC No Date): US 621322 (840615)
Applications (CC,No,Date): GB 8512060 (850513); DE 3521165 (850613)

Abstract (Basic): GB 2160335

The machine tool operator can determine those values for feed (f) anddepth of cut (DOC) (d) that are consistently effecive in the machining of any of a variety of materials on different size machine tools. Once certain defined **constraints** have been applied, settings for the resulting values of feed and DOC can be imposed on the machine tool manually by the operator Via means for adjusting the feed and means for adjusting DOC.

Alternatively, in place of employing manual adjustment of feed and DOC, these adjusting means may be automatically respositioned via control devices responsive to a programming medium, such as a numerical control tape prepared in, or converted to, machine language. The medium programmed with the final feed and DOC data for the part to be machined is downloaded to a controller at the machine to set the cutting conditions for a given number of passes to produce a given change in workpiece configuration.

USE - For machines of differing horse power. @(24pp Dwg.No. 2,4/6

Abstract (US): 8619 US 4584649

The method is carried out in **iterative** fashion by applying a series of **constraints** **fixing** maximum and minimum feeds and maximum and minimum DOC-to-feed ratios. Final feed and DOC are determined so as to satisfy the **constraints** with no change in horsepower (HP) requirements.

For satisfying the conditions imposed the final feed (ff) should be equal to root of difi/L and final DOC (df) should be equal to root of difiL where L = (d/f)max and fi and di are the initial feed and initial DOC, respectively, selected after satisfying the minimum (or maximum) feed criterion and the HP requirement. @(14pp

Abstract (GB): 8830 GB 2160335

A method of machining a workpiece with a machine tool employing a tool insert, said machine tool having means for adjusting feed of said tool insert and means for adjusting depth of cut of said tool insert, said method including the steps of: (a) calculating the horsepower (HPc) required at the cutting edge of the tool insert, (b) calculating a first approximation of the value of the depth of cut (d) to be used, (c) calculating a first approximation of the value for the feed (f) to be used, (d) determining the value of the ratio d/f, (e) comparing the

values of f and d/f to the values of preset **constraints** for fmin, fmax, (d/f)min and (d/f)max, (f) if f has a value less than fmin, assigning the value of fmin as the initial value of feed (fi) and decreasing the value of d as the initial value of depth ofcut (d1) such that d1 x f1 = d x f, (1) calculating the vlaue of (d1/f2) and (2) if (di/fi) has a value greater than (d/f)max, calculating the value of final feed (ff) and the value of final depth of cut (df) from the relationships ff = square root ((dixfi)/L) and df = square root (difixL) where L = (d/f)max, (g) if f has a value greater than fmax, assigning the value of fmax as the value of fi and calculating the value of (d/f1), has a value smaller than (d/f)min, assigning to (d/fi) the value of (d/f)min, (2) calculating the value of ff from the relationship: ff = d/(d/f)min and (3) assigning to df the value of d in the previous step, (h) if f has a value equal to or greater than fmin and less than or equal to fmax and if (d/f) has a value equal to or greater than (d/f)min and equal to or less than (d/f)max, then ff = f and df = d, (i) repositioning said means for adjusting the feed of said tool insert with respect to said workpiece to a feed having the value of ff, (j) repositioning said means for adjusting the depth of cut of said tool insert with respect to said workpiece to a depth of cut having the value of df and (k) proceeding with the machining operat

Derwent Class: T06; X25; R26; P56; R27; P54

Int Pat Class: **G05B-019/18** ; B23Q-015/12; G06F-015/46; B23B-000/00

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File 321:PLASPEC Materials Select DB 1996/May
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File 275:IAC(SM) Computer Database(TM) 1983-1996/Sep 10
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S1    2138977   (MATERIAL?(1W)REQUIREMENT? OR CAPACIT?()RESOURCE? OR FINIT-
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              R(1W)PROGRAM? OR SCHEDULING OR PLANNING
S2     231742   CONSTRAIN?
S3       2110   (LOOKAHEAD OR LOOK?()AHEAD OR HEURISTIC? OR ITERAT?) (S) (-
              REPAIR? OR RELAX? OR FIX???)
S4         87   S1(S)S2(S)S3
S5         76   RD (unique items)
S6         53   S5 NOT PD=>941011
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?t /3,k/all

6/3,K/1 (Item 1 from file: 275)
DIALOG(R)File 275:IAC(SM) Computer Database(TM)

01654871 SUPPLIER NUMBER: 15519807
Scheduling products with bills of materials using an improved Lagrangian relaxation technique. (Technical)
Luh, Peter B.; Czerwinski, Christopher S.
IEEE Transactions on Robotics and Automation, v10, n2, p99(13)
April, 1994
DOCUMENT TYPE: Technical ISSN: 1042-296X LANGUAGE: ENGLISH
RECORD TYPE: ABSTRACT

...ABSTRACT: product. In practice, a bill of materials may be quite complex, involving hundreds of parts to be processed on a number of limited resources, making **scheduling** difficult. This has forced many practitioners to turn to **Material Requirements Planning** and **heuristic** rules to perform **scheduling** . These methods are seldom integrated, however, resulting in unreliable completion times for products and, hence, low customer satisfaction. This paper addresses the issue of integrally **scheduling** parts that are related through a bill of materials for the purpose of improving the on-time performance of products as well as reducing work-in-process (WIP) inventory. The technique presented here is based on an existing Lagrangian **relaxation** (LR) approach for the **scheduling** of independent parts in a job shop. The current problem, however, is more complicated that the job shop problem because of the **constraints** between parts, imposed by the bill of materials. In order to make Lagrangian **relaxation** a variable approach to this problem, an auxiliary problem formulation with a modified subgradient method are adopted to improve the computation time of the existing LR approach. This improved LR approach allows the bill of material **constraints** to be considered directly in the problem formulation. Results to date show that the above integration improves product tardiness and WIP levels, compared to techniques that do not integrate the bill of material **constraints** into the product **scheduling** problem. The improved ability of a manufacturer to meet promised delivery dates for products by the above integration will ultimately enhance its credibility and competitiveness...

6/3,K/2 (Item 2 from file: 275)
DIALOG(R)File 275:IAC(SM) Computer Database(TM)

01521899 SUPPLIER NUMBER: 12353457 (USE FORMAT 7 OR 9 FOR FULL TEXT)
The continued debate on software patents. (ACM Forum) (Letter to the Editor)
Ritchie, Dennis M.; Vetillard, Eric; Hayden, Bruce E.; Sanders, Sidney L.; Jacobson, Robert; Johnson, Jeff; Wolinsky, Carol; Sylvester, James; Zoraster, Steven; Sawey, Ronald
Communications of the ACM, v35, n6, p13(7)
June, 1992
DOCUMENT TYPE: Letter to the Editor ISSN: 0001-0782 LANGUAGE: ENGLISH RECORD TYPE: FULLTEXT
WORD COUNT: 4865 LINE COUNT: 00385

... half-day search through journals devoted to operations research we were able to find one review article [10] and five application-oriented articles on course **scheduling** , classroom assignment, and the assignment

of teachers to classes [2, 3, 4, 6, 8]. Each application article formulates its particular version of the problem as a combinatorial optimization problem and describes custom coded optimization programs developed to solve them. All five programs use some combination of problem partitioning, **constraint relaxation** , problem specific **heuristics** , and user intervention to help find feasible solutions. Two of the programs have been used by colleges to solve real **scheduling** problems.

Doerschler and Freeman allocate exactly two sentence in their article to the possible use of mathematical optimization techniques to solve map name placement problems...

6/3,K/3 (Item 3 from file: 275)
DIALOG(R)File 275:IAC(SM) Computer Database(TM)

01373159 SUPPLIER NUMBER: 09424155 (USE FORMAT 7 OR 9 FOR FULL TEXT)
Scheduling in real time. (Unix operating system)
Locke, C. Douglass
UNIX Review, v8, n9, p48(7)
Sept, 1990
ISSN: 0742-3136 LANGUAGE: ENGLISH RECORD TYPE: FULLTEXT; ABSTRACT
WORD COUNT: 4151 LINE COUNT: 00340

ABSTRACT: Resource **scheduling** under real-time versions of the UNIX operating system is discussed. The goals of real-time operating systems include predictability; operation within all feasible application time **constraints** ; and compliance with all important time **constraints** . A real-time **scheduling** algorithm in the operating system's resource manager determines the sequence in which processes must share a computing resource. The five types of real-time schedules are the cyclic executive; the **fixed** -priority; the shortest-process-time; the earliest-deadline; and the shortest-slack-time. **Scheduling** parallel processors and expert systems usually involves **heuristics** and rule-firing decisions.

6/3,K/4 (Item 4 from file: 275)
DIALOG(R)File 275:IAC(SM) Computer Database(TM)

01268538 SUPPLIER NUMBER: 07162750
Probabilistic shortest path problems with budgetary constraints. (technical)
Bard, Jonathan F.; Miller, Jeanne L.
Computers & Operations Research, v16, n2, p145(15)
April, 1989
DOCUMENT TYPE: technical ISSN: 0305-0548 LANGUAGE: ENGLISH
RECORD TYPE: ABSTRACT

ABSTRACT: Formulating some **planning** and design problems as networks allows them to be solved with various commercial codes, but the codes only deal with deterministic formulations. When uncertainty is...

...made in the extended model that uncertainty can be reduced by allocating additional resources, but this raises the question of how best to spend a **fixed** budget so that expected returns are maximized. The answer is provided using a Monte Carlo simulation. An algorithm is presented for finding approximate solutions to **constrained** shortest path problems that have arc lengths that are random variables. A **heuristic** that uses a dynamic programming algorithm is used to solve **fixed** instances of the

probabilistic problem with a simulation framework.

6/3,K/5 (Item 5 from file: 275)
DIALOG(R)File 275:IAC(SM) Computer Database(TM)

01254267 SUPPLIER NUMBER: 06600176 (USE FORMAT 7 OR 9 FOR FULL TEXT)
Expert systems: picking the right problem. (systems architecture) (technical)
Aseo, Joseph
ESD: The Electronic System Design Magazine, v18, n8, p63(4)
Aug, 1988
DOCUMENT TYPE: technical ISSN: 0893-2565 LANGUAGE: ENGLISH
RECORD TYPE: FULLTEXT; ABSTRACT
WORD COUNT: 3253 LINE COUNT: 00262

... determine each goal. Thus, the search space is restricted and possible solutions can be evaluated quickly against the constraints.

For example, imagine the problem of **scheduling** airplanes arriving and leaving at different times, at a **fixed** number of terminal gates, to allow minimum connecting time for passengers, while maximizing the usage of gates. The **constraints** on these goals include estimated times of arrival and departure, type of airplane that can be accommodated at each gate, and grouping of connecting flights...

...flight delays and mechanical failures. An effort to define this problem using algorithms might prove frustrating due to the large number of dependencies between the **constraints** ants and the large number of possibilities. However, defining the problem in terms of **heuristics** reduces the problem space to a manageable level by allowing for **constraints** to be evaluated as related groups.

Filing in the Gaps

It is the ability to solve problems on a case-by-case basis that gives...

6/3,K/6 (Item 1 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00952033 96-01426
An exploration of concepts in system integration
Mejabi, Olugbenga O
Integrated Manufacturing Systems v5n4,5 PP: 5-12 1994
ISSN: 0957-6061 JRNL CODE: ING
AVAILABILITY: Fulltext online. Photocopy available from ABI/INFORM
WORD COUNT: 5605

...TEXT: section on system functionality.

An illustrative example in manufacturing is the case of a hypothetical material handling system with several automated guided vehicles. In route **planning** mode, each vehicle has the goal to minimize the total distance it travels, while the system controller has as its goal to maximize throughput. For...

... time segment, a decision must be made as to the path that each vehicle will follow as it moves from one station to another. When **planning** starts, each vehicle first determines the shortest distance path between

stations, and results are reported back to the controller. The controller applies a path congestion...
... sensitivity function to the results to determine if the throughput can possibly be improved. The sensitivity function also determines e paths which cause the greatest **constraint** on throughput. In the event that throughput can be improved, the controller initiates another **iteration** of the **planning** process by allowing a **relaxation** in the requirement for all vehicles to use the shortest distance path. The **iterative** process continues until the controller determines that the current plan provides for maximization of system throughput.

Architectural issues that are central to integrated system designs...

6/3,K/7 (Item 2 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00915976 95-65368
A deterministic maintenance scheduling problem for a group of non-identical machines
Hariga, Moncer
International Journal of Operations & Production Management v14n7 PP: 27-36 1994
ISSN: 0144-3577 JRNL CODE: IJO
AVAILABILITY: Fulltext online. Photocopy available from ABI/INFORM 15769.00
WORD COUNT: 3138

...TEXT: sub i T sub i ,--i = 1,2,...,m T sub i >= 0,--i = 0,1,...,m
(Equation omitted)

MINLP is a mixed integer non-**linear programme** that is very difficult to solve. For this type of optimization problem, **heuristic** methods are usually preferred since they provide near optimal solutions with less computational effort. To circumvent the difficulty of solving MINLP, we first construct and solve a **relaxed** version of MINLP. We then show how the solution to the **relaxed** problem can be used to find near optimal solution to MINLP. In the **relaxed** problem, we discard the **constraints** relating the cycle time with the minor overhaul interval of each machine. These **constraints** are replaced by others which state that the cycle time is larger than the minor overhaul intervals.

Therefore the relaxed problem can be written as...

6/3,K/8 (Item 3 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00897605 95-46997
A tabu search procedure for the Resource Constrained Project Scheduling Problem with Discounted Cash Flows
Icmeli, Oya; Erenguc, S Selcuk
Computers & Operations Research v21n8 PP: 841-853 Oct 1994
ISSN: 0305-0548 JRNL CODE: CRO
AVAILABILITY: Photocopy available from ABI/INFORM 49049.00

ABSTRACT: The Resource **Constrained** Project **Scheduling** Problem with Discounted Cash Flows (RCPSPDC) is considered. This problem involves **scheduling** the project activities with cash inflows and outflows in such

a way that the net present value of the cash flows is maximized subject to resource and precedence **constraints** . A tabu search procedure was proposed (TABU-S) as a **heuristic** solution technique for this problem. The procedure was then modified to invoke a long term memory function (TABU-L). Both procedures were tested on 50 problems derived from Patterson's data set. Solutions produced by these procedures were compared to upper bounds obtained from a **Linear Programming Relaxation** of RCPSPDC which is strengthened by valid cuts. Furthermore, a comparison of these solutions to solutions obtained by Minimum Slack **Heuristic** was provided. In general, Tabu Search successfully produced near-optimal solutions with reasonable computation effort. ...

6/3,K/9 (Item 4 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00860600 95-09992
The column subtraction algorithm: An exact method for solving weighted set covering, packing and partitioning problems
Harche, F; Thompson, G L
Computers & Operations Research v21n6 PP: 689-705 Jul 1994
ISSN: 0305-0548 JRNL CODE: CRO
AVAILABILITY: Photocopy available from ABI/INFORM 49049.00

...ABSTRACT: packing and partitioning problems is presented. The proposed algorithm is based on a new method, called the column subtraction (or row sum) method. First, a **linear programming relaxation** of the set problem is solved to optimality, using a specialized version of the pivot and probe algorithm of Sethi and Thompson, which has proved...

... tableau, one at a time from the right hand side column, is used to produce optimal integer solutions. The algorithm begins with a novel greedy **heuristic** that makes use of only the nonbasic surplus variables for the column substractions, and which generates excellent bounds quickly. Computational comparisons, based upon problems having up to 9000 variables and 800 **constraints** , highlight the effective overall performance of the column subtraction algorithm. ...

6/3,K/10 (Item 5 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00838937 94-88329
Economic development of groundwater in arid zones with applications to the Negev Desert, Israel
Brimberg, Jack; Mehrez, Abraham; Oron, Gideon
Management Science v40n3 PP: 353-363 Mar 1994
ISSN: 0025-1909 JRNL CODE: MCI
AVAILABILITY: Photocopy available from ABI/INFORM 1611.00

ABSTRACT: A mixed binary integer **linear program** is formulated to determine the economic development of marginal groundwater sources at local demand sites in an arid region. These marginal sources are required to augment the supply from an overloaded regional source. The model accounts for variable costs of supply, **fixed** investment costs, capacity **constraints** at the regional and local levels, and water quality requirements at the local sites. A Lagrangian **relaxation** sequence reduces the model to a series of simple local problems, the solution of

which provides an optimal sequence for developing the marginal groundwater sources while reducing the demands on the regional source. A **heuristic** and an exact procedure are also proposed to solve the problem for arbitrary levels of supply from the regional source. The theory is applied to...

6/3,K/11 (Item 6 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00818169 94-67561
Analyzing tradeoffs between zonal constraints and accessibility in facility location
Gerrard, Ross A; Church, Richard L
Computers & Operations Research v21n1 PP: 79-99 Jan 1994
ISSN: 0305-0548 JRNL CODE: CRO
AVAILABILITY: Photocopy available from ABI/INFORM 49049.00

...ABSTRACT: often is influenced by the desire to distribute equitably the impacts or benefits of facilities by locating them among multiple regions, districts, or zones. A **constrained** multiobjective model which can identify both supported non-dominated solutions and unsupported non-dominated solutions is presented. A special Lagrangian **relaxation** is exploited in the proposed solution methodology. This is a first attempt at using a Lagrangian based approach to identify unsupported non-dominated solutions to a location model. Results on 2 data sets with different types of zones show the Lagrangean approach to be efficient compared to **linear** -integer **programming** and a vertex substitution **heuristic** .

6/3,K/12 (Item 7 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00810319 94-59711
The multiproduct warehouse location problem: Applying a decomposition algorithm
Lee, Chong Y
International Journal of Physical Distribution & Logistics Management v23n6 PP: 3-13 1993
ISSN: 0960-0035 JRNL CODE: IPD
AVAILABILITY: Fulltext online. Photocopy available from ABI/INFORM 15770.01
WORD COUNT: 7436

...TEXT: which offers another type of decomposition technique that produces better bounds on the optimal solution. This decomposition is called the dual decomposition. Dual decomposition for **linear programming** is widely known as Dantzig-Wolfe decomposition. The dual decomposition algorithm solves successively a dual sub-problem and a master problem until the optimum is achieved and verified. Geoffrion[28] showed that the method can be generalized via Lagrangean **relaxation** to deal with mixed integer programming. This is called the dual decomposition or the Lagrangean **relaxation** method. The dual sub-problem is obtained by taking the Lagrangean **relaxation** of the original problem relative to some **constraints** . Each **iteration** consists of selecting a new set of Lagrangean multipliers by the dual master problem, and solving the dual sub-problem for the given values of the multipliers. The algorithm may become computationally attractive if the complicating **constraints** are **relaxed** so as to obtain a relatively easy to solve sub-problem. The dual decomposition algorithm effectively solves the formal Lagrangean dual

problem relative to the given subset of **constraints** . Lower bounds on the value of the minimization problem are obtained at every **iteration** of the dual decomposition algorithm. Lagrangean **relaxation** is based on the observation that many difficult integer programming problems can be modelled as a relatively easy problem, complicated by a set of side **constraints** . To exploit this observation, a Lagrangean problem is created in which the complicating **constraints** are replaced with a penalty term in the objective function involving the amount of violation of the **constraints** and their dual variables. The Lagrangean problem is easy to solve and provides a lower bound (for a minimization problem) on the optimal value of...

6/3,K/13 (Item 8 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00754110 94-03502
Feedback production planning in a stochastic two-machine flowshop: Asymptotic analysis and computational results
Sethi, Suresh; Yan, Houmin; Zhang, Qing; Zhou, Xun Yu
International Journal of Production Economics v30,31 PP: 79-93 Jul 1993
ISSN: 0925-5273 JRNL CODE: EPE
AVAILABILITY: Photocopy available from ABI/INFORM 42184.00

ABSTRACT: An asymptotic analysis is presented of heirarchical **production planning** in a manufacturing system with 2 tandem machines that are subject to breakdown and **repair** . Since the number of parts in the buffer between the 2 machines needs to be non-negative, the problem is inherently a state **constrained** problem. As the rate of machines breakdown and **repair** approaches infinity, the analysis results in a limiting problem in which the stochastic machine capacity is replaced by the equilibrium mean capacity. The value function for the original problem is proved to converge to the value function of the limiting problem. This suggests a **heuristic** to construct a feedback control for the original stochastic problem from the feedback control of the limiting deterministic problem. Computational results are presented to illusrate this **heuristic** .

6/3,K/14 (Item 9 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00743822 93-93043
A heuristic procedure for leasing channels in telecommunications networks
Kousik, Indira; Ghosh,. Deb; Murthy, Ishwar
Journal of the Operational Research Society v44n7 PP: 659-672 Jul 1993
ISSN: 0160-5682 JRNL CODE: OQT
AVAILABILITY: Photocopy available from ABI/INFORM

...ABSTRACT: these distributed systems. The assignment of communication channel capacities in the presence of time variant usage patterns is examined in general. Specifically, long-range capacity **planning** is examined for organizations that construct networks by leasing communication channels from telecommunication companies. The capacity assignment problem is formulated as a 0-1 integer program that seeks to minimize total leasing cost subject to communication delay restrictions. Unlike previous models that include a single-system wide-average delay **constraint** , the proposed model allows the flexibility of specifying delay restrictions by communicating node pairs. An efficient **heuristic** is proposed, along with

a Lagrangian **relaxation** based procedure to obtain performance guarantees on the solution obtained from the **heuristic** .

?t s6/3,k/15-53

6/3,K/15 (Item 10 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00739964 93-89185
An examination of resourcing policies for the multi-resource problem
Dumond, Ellen J; Dumond, John
International Journal of Operations & Production Management v13n5 PP: 54-76 1993
ISSN: 0144-3577 JRNL CODE: IJO
AVAILABILITY: Fulltext online. Photocopy available from ABI/INFORM 15769.00
WORD COUNT: 7042

...TEXT: of the richness of the problem, it rarely attempted to evaluate the effects of two or more tightly constrained resources.

In 9! a number of **heuristics** and due date assignment procedures in the dynamic, multi-resource, multi-project environment were studied. In that research, all the resources were **fixed** and **constrained** to the point where they were each available at 118 per cent (steady state utilization of 85 per cent). Performance was measured in terms of mean project completion time, total tardiness, and standard deviation of lateness. Their research was aimed at **heuristic** and promise-date performance and found that a combination of the First-in-System-First Seed IFS) **scheduling heuristic** and a newly developed due date rule, Scheduled Finish Time (SFT), performed far better than any others tested-including several due date-oriented **heuristics** . This combination of FIFS and SFT was also found to outperform all others tested in computer-based development projects by 10!. That work was extended in 11! to examine the effects of various availability levels of multiple resources in a dynamic project-**scheduling** environment and evaluated the effectiveness of various **scheduling heuristics** in this environment. They examined the case where multiple quantities of three different resources were required for the activities of projects arriving continuously throughout the time-horizon. In that study multiple **constrained** resources were provided at levels which permitted equal utilization; e.g. the three resource types were made available, so that each was used 91 per cent or 83 per cent or 77 per cent, etc. for a given treatment. They used a finite **scheduling** algorithm and associated **scheduling heuristics** to allocate multiple resources to competing projects. They found that, when resources are provided at availabilities of 150 per cent (utilization of 67 per cent), all **heuristics** performed well with regard to tardiness and completion times. Further, they found that, only when resources are tightly **constrained** (availability less than 125 per cent utilization of greater than 80 per cent), does the choice of **heuristic** make a significant difference with regard to completion time. One of the variables of interest in that experiment and this is mean completion time. The...

6/3,K/16 (Item 11 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00733731 93-82952
A comprehensive review of production lot-sizing
Eftekharzadeh, Reza
International Journal of Physical Distribution & Logistics Management v23n1 PP: 30-44 1993

ISSN: 0960-0035 JRNL CODE: IPD
AVAILABILITY: Fulltext online. Photocopy available from ABI/INFORM 15770.01
WORD COUNT: 11716

...TEXT: has stimulated major efforts by researchers towards developing heuristic solution procedures. The mixed integer programming (MIP) models are typically not used to solve real world **production scheduling** problems. One reason is that the standard MIP formulation for these problems often requires exorbitant solution times. At this point, it is necessary to explain...

... and J is an index set of integer variables. We assume that upper bounds on all of the variables are contained in the Bx >= b **constraints** . Problem LPMIP, the **linear programming relaxation** of MIP, is obtained by deleting the integrality requirements on all x sub j Ax >= a **constraints** can be referred to as coupling or complicating **constraints** and Bx >= b as special structure **constraints** . The complicating **constraints** typically include capacity **constraints** , load leveling **constraints** and so forth. The special structure **constraints** include demand and set-up forcing **constraints** . Solving MIP with an LP-based branch and bound code typically requires a great deal of computing time if the optimal solution value of LPMIP...

... MIP. Much of the research devoted to solving MIP involves enumerative methods. Perhaps the most successful approach for solving MIP to date is the Lagrangean **Relaxation** . Magnanti et al. 80! have shown the equivalence of the optimal values of the Lagrangian dual and column generation methods. Examples of papers using Lagrangean **Relaxation** include 19,81-85!. The subgradient algorithm in Thizy and Wassenhove 85! is implemented to minimize the processing costs and is based on a Lagrangean **Relaxation** of the capacity **constraints** imposed on the resources. The method incorporates a primal partitioning scheme with a network flow subproblem to obtain good feasible solutions. The algorithm in 85...

... for the single level or the incapacitated version of the problem (see Table I). There are some solution methodologies for multi-level capacitated lot size **scheduling** . One of them is a widely available branch and bound procedure, utilizes the integer-related **linear programming** solution to find lower bounds. With N*T 0-1 integer variables, the size of the problem is large even for small structures. This method...

... multilevel lot-sizing procedures. There are not many multi-level capacitated lot-sizing papers. Therefore, one approach could be: use a multi-level lot-sizing **heuristic** item-by-item, moving down the product structure from finished products to raw materials; when the work centre is to be scheduled, use a capacitated lot-sizing **heuristic** ; return to the multilevel method to continue **scheduling** all items down to the raw material level. The difficulty with this method is ensuring that the lots for successor items are not batched in...

...way that the production requirements are greater than available capacity in the early periods and the third method is a branch and bound using Lagrangean **Relaxation** to find a lower bound. The basic concept behind this approach is to place some **constraints** into the objective function using Lagrangean multipliers. If the **relaxed constraints** are selected cleverly, the resulting problem should be much easier to solve than the original problem. The lower bound from the **relaxed** problem, in many cases, is much better than the lower bound from the integer-**relaxed** **linear programming** solution, and also it is possible to find optimal or near optimal solutions to a problem.

Multi-stage structures can be organized in several ways...one period is solved first, then a two period problem, then three period problem, so on).

Coleman and McKnew 33! and Coleman 103! introduced a **heuristic** based on the technique for order placement and sizing (TOPS), a single-item technique utilizes a mechanism for linking interdependent lot-sizing decisions. The inputs...

... initial phase of simplified problems revealed practical indifference from optimality for the new algorithm. Phase 2 emphasized the relative strength and consistency of the proposed **heuristic** versus all other rules tested over more difficult examples. The final stage also identified environmental settings than were cases in which existing methods have been ...

... computationally effective and useful for determining the optimal solution-sized to medium-sized research problems. This is primarily due to the fact that the associated **constraint** guarantees an integer solution to the **relaxed** LP, but also because of the variable reduction algorithm, which restricts the number of variables and **constraints** associated with extended **planning** horizons. Its long-term use will probably be restricted to evaluating the performance of **heuristic** routines that have the computational ability to address large problems. The proposed formulation can be modified to allow for product commonality and multiple end items...

6/3,K/17 (Item 12 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00725133 93-74354
The Multiple Depot Vehicle Routing Problem with Backhauling
Min, Hokey; Current, John; Schilling, David
Journal of Business Logistics v13n1 PP: 259-288 1992
ISSN: 0735-3766 JRNL CODE: JBL
AVAILABILITY: Fulltext online. Photocopy available from ABI/INFORM 16365.00
WORD COUNT: 5572

...TEXT: 3 lists the 13 capacitated vendor clusters which include the original 27 vendors.(Table 3 omitted)

AGGREGATE TOUR BUILDING PHASE. The second step of the **heuristic** is to design the aggregate routes. This is accomplished by solving the integer program, (1)-(5). The possible routes, X sub ijk , were determined using...

... Although the formulation has binary integer restrictions, (5), for the decision variables, the problem yielded pure integer solutions when it was solved as a continuous **linear program** by **relaxing** these restrictions because its formulation is quite similar to an assignment problem formulation. **Constraint** set (4) was employed as the depot capacity **constraint** with T sub k = 6, for all k. The solution of this problem required 5.22 CPU seconds using Marstern's XMP mathematical programming package...

6/3,K/18 (Item 13 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00661881 93-11102

Early-tardy cost trade-offs in resource constrained projects with cash flows: An optimization-guided heuristic approach
Padman, Rema; Smith-Daniels, Dwight E
European Journal of Operational Research v64n2 PP: 295-311 Jan 22, 1993
ISSN: 0377-2217 JRNL CODE: EJO
AVAILABILITY: Photocopy available from ABI/INFORM 42124.00

ABSTRACT: The resource **constrained** project **scheduling** problem is examined with the objective of maximizing the net present value (NPV) of project cash flows. Eight greedy **heuristics** are presented, embedded in a single-pass, forward algorithm that uses information from a **relaxed** optimization model to schedule activities. In contrast to previous research, activities are released for **scheduling** when they are precedence feasible. The **heuristics** require the evaluation of the earliness costs and tardiness penalties for each activity that are provided by the **relaxed** optimization model. The performance of these **heuristics** is compared to that of **heuristics** from the earlier research that delay the consideration of an activity for **scheduling** until the activities' target time specified by the optimization model becomes current. The results of a series of experiments across 144 different experimental environments indicate that the early release **heuristics** provide superior NPV results in many project environments. ...

6/3,K/19 (Item 14 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00639984 92-54924
A Hybrid Approach to Multi-Objective Linear Optimization
Buchanan, John
Journal of the Operational Research Society v43n9 PP: 928-931 Sep 1992
ISSN: 0160-5682 JRNL CODE: OQT
AVAILABILITY: Photocopy available from ABI/INFORM

ABSTRACT: Poh and Quaddas (1990) introduced a hybrid solution method for solving multi-objective **linear programs** (MOLP). The Poh and Quaddas method uses a game theory formulation to derive a single composite objective function. At each **iteration**, this composite objective is optimized and the decision maker can **relax** the bounds for some objectives. Poh and Quaddas claim that the hybrid method is easy to use and illustrate the operation of the method with...

... that the decision maker has little explicit control over and the inability of the method of Poh and Quaddas to converge, even with some objectives **constrained** to their optimum values. ...

6/3,K/20 (Item 15 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00626618 92-41720
A Comparison of Two Lot Sizing-Sequencing Heuristics for the Process Industry
Heuts, R. M. J.; Seidel, H. P.; Selen, W. J.
European Journal of Operational Research v59n3 PP: 413-424 Jun 25, 1992
ISSN: 0377-2217 JRNL CODE: EJO
AVAILABILITY: Photocopy available from ABI/INFORM 42124.00

ABSTRACT: Two **heuristics** for operational **production planning** in a chemical processing environment are compared, characterized by a single bottleneck machine, **fixed** batch sizes, sequence-dependent setup times, as well as production and storage **constraints** . The object of the analysis is to determine a feasible production plan for a pre-defined **planning** horizon such that customer demand is satisfied, machine capacity and storage **constraints** are not violated, and switch-over and inventory holding costs are minimized. Performance of both **heuristics** is measured by means of simulation experiments in which the **planning** horizon is partially frozen and rolled a number of times, as would be the case in practical applications. The performance measure used is the total cost for executing a particular plan over its entire **planning** horizon. Both **heuristics** yielded statistically significantly lower costs in all experiments, as compared to the initial feasible production plan. These experiments therefore indicate that both **heuristics** could be used effectively in improving production plans for a wide variety of process industry applications. ...

6/3,K/21 (Item 16 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00624245 92-39347
Deterministic Approximations to Co-Production Problems with Service Constraints and Random Yields
Bitran, Gabriel R.; Leong, Thin-Yin
Management Science v38n5 PP: 724-742 May 1992
ISSN: 0025-1909 JRNL CODE: MCI
AVAILABILITY: Photocopy available from ABI/INFORM 1611.00
Article Ref. No.: B-MCI-65-9

ABSTRACT: **Production planning** problems where multiple item categories are produced simultaneously are examined. The items have random yields and are used to satisfy the demands of many products...

... satisfy the demand of other products when it conforms to their specifications. Customers' demand must be satisfied from inventory. The problem is formulated with service **constraints** and a near-optimal solution is provided to the problem with a **fixed planning** horizon. Simple **heuristics** are proposed for the problem solved with a rolling horizon. Some of the **heuristics** performed very well over a wide range of parameters. ...

6/3,K/22 (Item 17 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00594555 92-09728
Scheduling of Project Networks by Job Assignment
Drexl, Andreas
Management Science v37n12 PP: 1590-1602 Dec 1991
ISSN: 0025-1909 JRNL CODE: MCI
AVAILABILITY: Photocopy available from ABI/INFORM 1611.00
Article Ref. No.: B-MCI-60-9

ABSTRACT: A recurring problem in project management involves the allocation of scarce resources to the individual jobs comprising the project. In many situations, such as audit **scheduling** , the resources correspond to

individual skilled laborers, leading to an assignment type project **scheduling** problem. The nonpreemptive variant of a resource-**constrained** project job-assignment problem is considered, where job durations as well as costs depend upon the assigned resource. Regarding precedence relations as well as release...

... minimize overall costs. To solve the time-resource-cost-tradeoff problem, a hybrid brand and bound-dynamic programming algorithm with a (efficient Monte Carlo type) **heuristic** upper bounding technique and various **relaxation** procedures for determining lower bounds are used. The stochastic assignment **heuristic** seems to be a highly suitable method for approximately solving the problem presented. ...

6/3,K/23 (Item 18 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00586449 92-01622
Airline Buyout: Evolutionary Systems Design and Problem Restructuring in Group Decision and Negotiation
Shakun, Melvin F.
Management Science v37n10 PP: 1291-1303 Oct 1991
ISSN: 0025-1909 JRNL CODE: MCI
AVAILABILITY: Photocopy available from ABI/INFORM 1611.00
Article Ref. No.: B-MCI-58-11

...ABSTRACT: of the problem representation in group decision and negotiation support systems is discussed. The evolutionary systems design (ESD) approach to restructuring is developed involving a **heuristic** controls-goals-values referral process and other domain-independent methodological knowledge, such as **constraint relaxation** , contingency **planning** , coalition formation, and flexible goal target. These ideas are applied to multiple problem restructuring in a scenario motivated by labor-management negotiations and buyout in...

6/3,K/24 (Item 19 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00564714 91-39068
Multilevel Capacitated Lotsizing Complexity and LP-Based Heuristics
Maes, Johan; McClain, John O.; Van Wassenhove, Luk N.
European Journal of Operational Research v53n2 PP: 131-148 Jul 25, 1991
ISSN: 0377-2217 JRNL CODE: EJO
AVAILABILITY: Photocopy available from ABI/INFORM 42124.00

ABSTRACT: The first **heuristics** capable of solving multilevel lotsizing problems with capacity **constraints** on more than one level are presented. The form of the **heuristics** is quite general so that they can easily be extended to solve a variety of problems. With realistic lotsizing problems, the main complexity factor for the design of **heuristics** is the occurrence of setup times. If setup time consumes part of the limited capacity, finding a feasible solution is NP-complete. Checking feasibility for...

... done in polynomial time. However, constructing a feasible solution can be quite intricate. The complexity issues point to mathematical programming as a potential source of **heuristics** for these problems. A new approach based on rounding a **linear programming** (LP) solution for the problem

without setup times is presented. The **heuristics** try to curtail the enumeration process using information from the problem structure and LP **relaxation** of the model. Tests on small problems show that these **heuristics** perform rather well under various circumstances.
...

6/3,K/25 (Item 20 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00503318 90-29075
Heuristic Procedures for Multi-Item Inventory Planning with Limited Storage
Dixon, Paul S.; Poh, Choon Lay
IIE Transactions v22n2 PP: 112-123 Jun 1990
ISSN: 0740-817X JRNL CODE: AIE
AVAILABILITY: Photocopy available from ABI/INFORM 3180.00
Article Ref. No.: B-AIE-11-5

ABSTRACT: The determination of replenishment quantities for multiple products with dynamic demand, subject to storage **constraints** , is examined. It is assumed that **planning** is done at discrete time intervals, demands and space availability are dynamic, and production and holding costs are concave. Ignoring the inventory restrictions, the problem is a classic dynamic lot-size problem. Mitten's (1975) algorithm is modified to accommodate a dynamic budget **constraint** . Several new **heuristics** , based on a **linear programming** (LP) **relaxation** and a Lagrangean **relaxation** , are proposed and evaluated. The application of a smoothing **heuristic** to candidate solutions generated by applying subgradient optimization to the Lagrangean **relaxation** , seemed to consistently give near optimal solutions without excessive computations. An important side benefit of this approach is that a lower bound on the optimum is also generated, thereby giving a measure of the quality of the **heuristic** solution. ...

6/3,K/26 (Item 21 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00500873 90-26630
Set Partitioning and Column Generation Heuristics for Capacitated Dynamic Lotsizing
Cattrysse, Dirk; Maes, Johan; Van Wassenhove, Luk N.
European Journal of Operational Research v46n1 PP: 38-47 May 4, 1990
ISSN: 0377-2217 JRNL CODE: EJO
AVAILABILITY: Photocopy available from ABI/INFORM 42124.00

ABSTRACT: Set partitioning and column generation **heuristics** for multi-item, single-level capacitated dynamic lot-sizing problems are discussed. A different approach is proposed in which candidate plans also are generated by some well-known multi-item capacitated dynamic lot-sizing **heuristics** . When many items are to be lot-sized on a common **constrained** facility over a relatively short horizon, the problem is rather simple and all **heuristics** perform rather well. However, when the number of items approaches the number of periods, the performance of commonsense **heuristics** deteriorates and the set partitioning and column generation-based approaches tend to work better. When the complexity of the problem comes from few items that...

... many periods, the set partitioning and column generation-based approaches do not do much to solve the problem, since the number of fractionals in the **linear programming** (LP) **relaxation** is high and the final integer solution is determined largely by the rounding algorithm. One possibility would be to use a dynamic programming approach. ...

6/3,K/27 (Item 22 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00496515 90-22272
Linear Programming on Cray Supercomputers
Beasley, J. E.
Journal of the Operational Research Society v41n2 PP: 133-139 Feb 1990
ISSN: 0160-5682 JRNL CODE: OQT

ABSTRACT: Computational experience with a **linear programming** (LP) code on 2 Cray supercomputers is presented. The LP code that is used is the simplex-based, in-core FORTRAN code due to Marsten...

... Balas and Ho (1980). Problems of this type are reputed to be difficult to solve using primal simplex. The 2nd set of problems were LP **relaxations** generated assignment problems. This set had a reasonable number of **constraints** and a large number of variables. The 3rd set consisted of LP **relaxations** of randomly generated assignment problems, generated so as to have only about 100,000 variables. It is concluded that: 1. the choice of primal or...

... significant effect on solution time and on whether a problem is solved, 2. a least-squares regression for dual simplex indicates that the number of **iterations** is approximately 0.4731, and 3. significant improvements appear to be possible by recoding to enable greater advantage to be taken of vector processing. ...

6/3,K/28 (Item 23 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00493170 90-18927
Operational Production Planning in a Chemical Manufacturing Environment
Selen, W. J.; Heuts, R. M. J.
European Journal of Operational Research v45n1 PP: 38-46 Mar 6, 1990
ISSN: 0377-2217 JRNL CODE: EJO
AVAILABILITY: Photocopy available from ABI/INFORM 42124.00

ABSTRACT: A **heuristic** is developed for operational **production planning** in a chemical processing environment that is characterized by a single bottleneck machine, **fixed** batch sizes, sequence-dependent setup times, and production and storage capacity **constraints** . The algorithm aims at preproducing future production requirements in order to reduce the total relevant cost, which consists of inventory holding costs and opportunity costs...

... an approximate traveling salesman algorithm. A numerical example is provided that determines production lot sizes and production sequences for 15 products over a 20-week **planning** horizon under tight capacity conditions. ....

6/3,K/29 (Item 24 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00492091 90-17848
The Equity Constrained Shortest Path Problem
Gopalan, Ram; Batta, Rajan; Karwan, Mark H.
Computers & Operations Research v17n3 PP: 297-307 1990
ISSN: 0305-0548 JRNL CODE: CRO
AVAILABILITY: Photocopy available from ABI/INFORM 49049.00

ABSTRACT: An examination was conducted of the problem of finding the shortest path on a computer network subject to "equity" **constraints** . Applications for this problem included: 1. routing a vehicle transporting hazardous materials, 2. routing a police car through a city, and 3. **planning** a politician's campaign tour. Computational experience was based on a 50-node network derived from the city and county of Albany, New York. A Lagrangean dual bounding approach was employed that **relaxed** the complicating **constraints** of the problem. After solving the Lagrangean dual, the duality gap was closed by finding the t shortest paths with regard to the Lagrangean function. Both looping and loopless paths were considered, and subgradient algorithms were developed for these problems. In addition, a quick-and-dirty **heuristic** procedure was developed.
...

6/3,K/30 (Item 25 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00490921 90-16678
Resource-Constrained Scheduling of Projects with Variable-Intensity Activities
Leachman, Robert C.; Dincerler, Abdurrezak; Kim, Sooyoung
IIE Transactions v22n1 PP: 31-40 Mar 1990
ISSN: 0740-817X JRNL CODE: AIE
AVAILABILITY: Photocopy available from ABI/INFORM 3180.00
Article Ref. No.: B-AIE-10-5

ABSTRACT: Resource- **constrained** **scheduling** of projects is considered, including activities whose resource loading is flexible. A model of project-oriented production is proposed in which the application rates of the various resources required by an activity are indexed by the performance speed or intensity of the activity. **Heuristic** algorithms are introduced for the assignment of activity intensities through time in lieu of traditional, **fixed** -intensity start-time **scheduling** . On test problems taken from the literature, the assignment algorithms are shown to outperform even optimal **scheduling** algorithms for the **fixed** -intensity case. The assignment algorithms are computationally practical for **scheduling** actual, large-scale industrial projects. The model and the assignment algorithms are extended to admit production-like workflow dependencies and to interface with aggregate models for multiproject **planning** .

6/3,K/31 (Item 26 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00457853 89-29640
Location Problems Arising in Computer Networks
Boffey, T. B.
Journal of the Operational Research Society v40n4 PP: 347-354 Apr 1989
ISSN: 0160-5682 JRNL CODE: OQT

ABSTRACT: The **planning** and organization of computer networks generate many location problems. These may be split into those mainly concerned with placement of hardware and those concerned with...

... of hardware in computer networks. These include: 1. traffic assignment, 2. network design, 3. capacitated and uncapacitated location, 4. generalized assignment, 5. multiconstraint knapsack, 6. **constrained** spanning tree, 7. traveling salesman, and 8. vehicle routing. Many techniques have been used to solve the problems, including dynamic programming, branch and bound, Lagrangean **relaxation** , surrogate **relaxation** , dual ascent, and various **heuristics** .

6/3,K/32 (Item 27 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00395026 88-11859
A Two-Machine Flow Shop Scheduling Problem with Controllable Job Processing Times
Nowicki, Eugeniusz; Zdrzalka, Stanislaw
European Journal of Operational Research v34n2 PP: 208-220 Mar 1988
ISSN: 0377-2217 JRNL CODE: EJO
AVAILABILITY: Photocopy available from ABI/INFORM 42124.00

ABSTRACT: A 2-machine flow shop **scheduling** problem with zero ready times and no precedence **constraints** is considered. Processing times and the sequence of jobs are decision variables that take their values from given closed intervals on the real line. The...

... completion time cost. The analysis indicates that the decision form of the problem is NP-complete, even when the processing times on one machine are **fixed** and all the processing cost units are the same. This means that the optimization problem is NP-Hard, suggesting that there probably is no efficient algorithm that will solve even the simplest version of the problem. Two efficient **heuristic** algorithms for solving the problem are derived. Their worst-case performance ratios are equal to 2 and 3/2.
...

6/3,K/33 (Item 28 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00346065 87-04899
A Simple Strategy for Solving a Class of 0-1 Integer Programming Models
Fox, G. Edward; Scudder, Gary D.
Computers & Operations Research v13n6 PP: 707-712 1986
ISSN: 0305-0548 JRNL CODE: CRO
AVAILABILITY: Photocopy available from ABI/INFORM 49049.00

ABSTRACT: A strategy is proposed for solving certain generalized set packing models. The strategy is based on employing a recently developed **heuristic** coupled with the solution of the **linear programming**

relaxation of the model. The Gomory cutting plane algorithm has been proved effective on the class of set covering models, which are special cases of the...

... suggests that the proposed strategy is superior to the Gomory algorithm and that it appears to perform relatively better on models with relatively higher density **constraint** coefficient matrices. ...

6/3,K/34 (Item 29 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00308968 86-09382
Heuristics and Reduction Methods for Multiple Constraints 0-1 Linear Programming Problems
Freville, A.; Plateau, G.
European Journal of Operational Research v24n2 PP: 206-215 Feb 1986
ISSN: 0377-2217 JRNL CODE: EJO
AVAILABILITY: Photocopy available from ABI/INFORM 42124.00

ABSTRACT: The efficient results relative to the 0-1 knapsack problem are extended to the multiple inequality **constraints** 0-1 **linear programming** problems. The 2 crucial phases for the solving of this kind of problem are presented. First, 2 linear expected time complexity greedy algorithms are proposed for the determination of a lower bound on the optimal value by employing a cascade of surrogate **relaxations** of the original problem whose sizes are decreasing step by step. A comparative study with the best-known **heuristic** procedures is reported; it concerns the accuracy of the approximate solutions and the practical computational times. Second, this greedy algorithm is inserted in an efficient reduction framework. Variables and **constraints** are eliminated by the conjunction of tests applied to Lagrangean and surrogate **relaxations** of the basic problem. Many computational results are summarized by considering test problems of the literature. ...

6/3,K/35 (Item 30 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00304622 86-05036
A General Phase-I Method in Linear Programming
Maros, Istvan
European Journal of Operational Research v23n1 PP: 64-77 Jan 1986
ISSN: 0377-2217 JRNL CODE: EJO
AVAILABILITY: Photocopy available from ABI/INFORM 42124.00

ABSTRACT: Phase I of the simplex method produces a basic feasible solution to **linear programming** problems. Phase I procedures can also be employed for generating feasible points of other problems with linear **constraints** . The traditional Phase I methods operate under the following conditions: 1. The incoming variable takes a feasible value. 2. The feasible basic variables remain feasible after a transformation. 3. The outgoing variable leaves the basis at a feasible level. A procedure, called FEWPHI, based on **relaxing** condition 2 is presented from which more efficient **iterations** can be expected in Phase I simply because of the new way of determining the outgoing variable. FEWPHI is then combined with an adaptive composite...

6/3,K/36 (Item 31 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00300829 86-01243
Integrated Days Off and Shift Personnel Scheduling
Bailey, James
Computers & Industrial Engineering v9n4 PP: 395-404 1985
ISSN: 0360-8352 JRNL CODE: CIE
AVAILABILITY: Photocopy available from ABI/INFORM 49045.00

ABSTRACT: Personnel **scheduling** traditionally has been solved at 2 separate but related levels: 1. determination of the days an employee should work, and 2. determination of the time an employee should start each workday. An attempt is made to provide a more robust solution to the integrated personnel **scheduling** problem. The solution is formulated as a decomposable **linear program** with unique properties. The integration permits **constraints** involving hourly fluctuations in demand and **fixed** workforce size to interact. The aim is to minimize the cost of premium pay plus customer inconvenience due to understaffing. The proposed **linear programming** model is compared with 2 alternative formulations: 1. the one-phase tour **heuristic** of McGinnis et al. (1978), and 2. a modification of the 2-phase optimization suggested by Baker (1976) and Field (1983). Compared to the 2...

6/3,K/37 (Item 32 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00292854 85-33288
On the Selection of Primary Paths for a Communication Network
Tcha, Dong-wan; Maruyama, Kiyoshi
Computer Networks & ISDN Systems v9n4 PP: 257-265 Apr 1985
ISSN: 0376-5075 JRNL CODE: CNI
AVAILABILITY: Photocopy available from ABI/INFORM 42155.00

...ABSTRACT: restricted to a set of preselected paths for each node pair. The problem is delineated as a mixed zero-one linear model with multiple-choice **constraints** . A **heuristic** algorithm is suggested, which uses a straightforward **iterative** approach, conceptually similar to that of the Simplex technique, for finding the characterized local optimal solution. Several subprocedures that exploit the special structure of the model are incorporated to make the algorithm computationally efficient. The **relaxed linear programming** model is employed for analysis of the algorithm, and its solution is found to be a tight lower bound. Applications of the algorithm to problems...

6/3,K/38 (Item 33 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00289773 85-30207
Zero-One Integer Programs with Few Constraints - Lower Bounding Theory
Gavish, Bezalel; Pirkul, Hasan
European Journal of Operational Research v21n2 PP: 213-224 Aug 1985
ISSN: 0377-2217 JRNL CODE: EJO
AVAILABILITY: Photocopy available from ABI/INFORM 42124.00

...ABSTRACT: subproblems. An important special case of the 0-1 integer programming problem is the multiconstraint knapsack problem. In the present paper, Lagrangian, surrogate, and composite **relaxation** techniques are introduced for obtaining lower bounds to the 0-1 integer programming problem. The theoretical basis for deriving multipliers used in these **relaxations** is examined. **Heuristic** procedures are then developed for determining surrogate multipliers for achieving lower bounds of good quality. In extensive computational testing, surrogate **relaxation** is shown to yield tight bounds within reasonable computation time for 0-1 integer programming problems with few **constraints** . Therefore, surrogate **relaxation** offers a viable alternative to **linear programming** and Lagrangian **relaxation** . These results serve as the basis for developing the efficient branch-and-bound procedure for 0-1 integer program solution as described in Gavish and...

6/3,K/39 (Item 34 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00277431 85-17865
DISPLAN: A Multiproduct Plant/Warehouse Location Model with Nonlinear Inventory Costs
Ballou, Ronald H.
Journal of Operations Management v5n1 PP: 75-90 Nov 1984
ISSN: 0272-6963 JRNL CODE: JOT
AVAILABILITY: Photocopy available from ABI/INFORM 14422.00

ABSTRACT: A **heuristic** computer model called Distribution Planner (DISPLAN) is described that is employed for strategic **planning** of physical supply and distribution networks. The model includes a nonlinear inventory-warehouse demand throughput relationship that is frequently crucial to the accurate analysis of locations. The structure of the model consists of this cost relationship plus: 1. warehouse **fixed** costs, 2. plant and warehouse capacity restrictions, 3. variable warehousing, 4. order processing, 5. transportation, 6. production purchase costs, and 7. customer service restrictions. DISPLAN uses the 3-dimensional transportation algorithm of **linear programming** in an **iterative** manner to converge on the minimum cost network configuration subject to the above **constraints** . DISPLAN has been applied to numerous network configuration problems in various industries, including retailing, manufacturing, and spare parts distributions. The method has exhibited modest computer...

6/3,K/40 (Item 35 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00256597 84-35158
A Branch-and-Bound Algorithm for the Multi-Level Uncapacitated Facility Location Problem
Tcha, Dong-wan; Lee, Bum-il
European Journal of Operational Research v18n1 PP: 35-43 Oct 1984
ISSN: 0377-2217 JRNL CODE: EJO
AVAILABILITY: Photocopy available from ABI/INFORM 42124.00

...ABSTRACT: facilities. The goal is to determine the optimal set of facilities to open for each distribution level, which minimizes the total distribution costs, including the **fixed** costs associated with opening them. The problem is formulated as a mixed integer **linear program** with

''tight'' or ''disaggregated'' **constraints** , so that Erlenkotter's (1978) and Bilde and Krarup's (1977) dual-based scheme of ''dual ascent procedure'' can successfully be included in the branch-and-bound solution method used. In addition, a **heuristic** ''primal descent procedure'' and some efficient node simplification procedures are introduced. Although the approach can be applied to any multilevel case, computational experiments are conducted...

6/3,K/41 (Item 36 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00241806 84-20366
Approximation Algorithms for the m-Dimensional 0-1 Knapsack Problem: Worst-Case and Probabilistic Analyses
Frieze, A. M.; Clarke, M. R. B.
European Journal of Operational Research v15n1 PP: 100-109 Jan 1984
ISSN: 0377-2217 JRNL CODE: EJO
AVAILABILITY: Photocopy available from ABI/INFORM 42124.00

...ABSTRACT: the multi-dimensional 0-1 knapsack problem is presented. This scheme runs in polynomial time in terms of input length when the number of problem **constraints** is considered to be a **fixed** constant. The scheme is based on the **linear programming** dual simplex algorithm, which provides an upper bound on the number of **iterations** required for problem solution. A probabilistic analysis of a particular random model of the problem yields satisfactorily tight bounds for the asymptotic properties of the objective function, allowing the solution to the **linear program** to be rounded down to obtain a satisfactory solution to the problem. ...

6/3,K/42 (Item 37 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00209564 83-21125
On Flow Shop Scheduling with Release and Due Dates to Minimize Maximum Lateness
Grabowski, Jozef; Skubalska, Ewa; Smutnicki, Czeslaw
Journal of the Operational Research Society v34n7 PP: 615-620 Jul 1983
ISSN: 0160-5682 JRNL CODE: OQT

ABSTRACT: Grabowski (1980) developed a branch-and-bound algorithm that incorporated release and due date requirements to minimize maximum lateness in the 2-machine **scheduling** problem. The Grabowski algorithm is extended to minimizing maximum lateness in flow shop **scheduling** problems involving an arbitrary number of machines. Machine capacity **constraints** are **relaxed** to derive lower bounds for the solution, which are strengthened through the development of a **heuristic** technique. Computational results are presented for flow shop problems involving up to 50 jobs. Increasing the number of jobs does not significantly affect computational efficiency ...

6/3,K/43 (Item 38 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00199682 83-11243

An Algorithm for Single Machine Sequencing with Deadlines to Minimize Total Weighted Completion Time
Potts, C. N.; Van Wassenhove, L. N.
European Journal of Operational Research v12n4 PP: 379-387 Apr 1983
ISSN: 0377-2217 JRNL CODE: EJO
AVAILABILITY: Photocopy available from ABI/INFORM 42124.00

...ABSTRACT: thus reducing the number of partial schedules that must be considered and allowing deadline adjustments. Upper bounds of the solution are identified with a backward **scheduling heuristic** . Lower bounds are computed through the use of a multiplier adjustment method based on Lagrangian **relaxation** of the deadline **constraints** . The algorithm is found to yield optimal solutions and to be computationally efficient in application to a problem having as many as 50 jobs. ...

6/3,K/44 (Item 39 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00195939 83-07500
Solving an Electricity Generating Capacity Expansion Planning Problem by Generalized Benders' Decomposition
Bloom, Jeremy A.
Operations Research v31n1 PP: 84-100 Janeb 1983
ISSN: 0030-364X JRNL CODE: OPR
AVAILABILITY: Photocopy available from ABI/INFORM 15117.00

ABSTRACT: This analysis addresses the application of generalized Benders' decomposition in a model for **planning** least-cost investments in electricity generating capacity that is subject to probabilistic reliability **constraints** . The **planning** problem is decomposed into: 1. a master problem, and 2. a set of subproblems, each representing the operation of a set of generating plants of **fixed** capacity in one year. Solutions to the subproblems are derived using a procedure termed probabilistic simulation that calculates: 1. the expected cost of operating the...

... system, 2. the reliability level, and 3. dual multipliers that reflect the value of small changes in the plant capacities. The master problem is a **linear program** that makes use of these dual multipliers to approximate the nonlinear cost and reliability functions. **Iteratively** solving the master problem and the subproblems leads to the solution of the capacity expansion problem. ...

6/3,K/45 (Item 40 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00194191 83-05752
Planning Production in a Bottleneck Department
Van Wassenhove, Luk N.; Vanderhenst, Pieter
European Journal of Operational Research v12n2 PP: 127-137 Feb 1983
ISSN: 0377-2217 JRNL CODE: EJO
AVAILABILITY: Photocopy available from ABI/INFORM 42124.00

ABSTRACT: A **production planning** model developed for a set of bottleneck machines in a large chemical firm is described. Production start-up and stopping costs for the machines are...

... machines; the idle periods are needed to adjust to overcapacity or to perform preventive maintenance. Production costs are balanced against inventory holding costs and workforce **constraints** through the use of Lagrangian **relaxation** and dynamic programming. A capacitated lot size **heuristic** for each machine is used to determine production lot sizes and **schedules** . **Production** sequences are planned through the use of a traveling salesman algorithm. ...

6/3,K/46 (Item 41 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00133612 81-03383
Optimal Multi-Level Lot Sizing for Requirements Planning Systems
Steinberg, Earle; Napier, H. Albert
Management Science v26n12 PP: 1258-1271 Dec 1980
ISSN: 0025-1909 JRNL CODE: MCI
AVAILABILITY: Photocopy available from ABI/INFORM 1611.00

...ABSTRACT: of advanced information systems has radically changed the practice of dependent demand inventory management, recent research having focused on development of multi-level lot sizing **heuristics** for these systems. An optimal procedure is developed by modeling the integrated multi-level production inventory system as a **constrained** , generalized network having **fixed** change arcs and side **constraints** . This network allows for the **relaxation** of the more restrictive assumptions of previous models such as those designed for product structures with single sources or successors. The solution to the resulting minimum cost flow problem yields optimal lot sizing decisions for purchasing, inventory, assembly and/or production activities at all levels over a finite **planning** horizon. The suitability of this approach for modeling complex requirements **planning** systems is clearly illustrated, beginning with a master **production schedule** and bills of material. ...

6/3,K/47 (Item 42 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00126948 80-20999
The Solution of a Railway Locomotive Scheduling Problem
Booler, J. M. P.
Journal of the Operational Research Society v31n10 PP: 943-948 Oct 1980
ISSN: 0160-5682 JRNL CODE: OQT

...ABSTRACT: work load of a railway system is governed by a list of jobs which represent train movements between various stations/depots, and the basic locomotive **scheduling** problem is that of finding a set of locomotive workings which cover the necessary jobs at the minimum cost. Each job is of a given duration and may have a **fixed** starting time or a range of possible starting times. Limits of the range are laid down by the commercial **constraints** of the traffic carried. A method is proposed that deals with both of these possibilities. For the case when the times the trains start are variable, it determines the time at which each job should start in accordance with the minimum cost criterion. The **heuristic** method is based on a **linear programming** model, and it provides good integer solutions. Figure. ...

6/3,K/48 (Item 43 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00086624 79-01512
Zero-One Programming with Many Variables and Few Constraints
Soyster, A. L.; Lev, B.; Slivka, W.
European Journal of Operational Research v2n3 PP: 195-201 May 1978
ISSN: 0377-2217 JRNL CODE: EJO
AVAILABILITY: Photocopy available from ABI/INFORM 42124.00

...ABSTRACT: was first introduced by E. Balas. An algorithm and computational experience has been provided for solving zero-one integer programs with many variables and few **constraints** . Sub-problems solved by implicit enumeration are generated from the **linear programming relaxation** , and the variables in these sub-problems correspond to the fractional variables that are obtained in the **linear program** . Because the number of fractional variables in the **linear program** is bounded by the number of **constraints** in the **linear program** , sub-problems will generally contain many fewer variables than the original zero-one integer program. Even though convergence to optimality within a modest number of **iterations** generally cannot be expected, the algorithm rather uniformly obtains a feasible integer solution in a few **iterations** which is very close to optimality for the major portion of test problems. Appendices.
...

6/3,K/49 (Item 44 from file: 15)
DIALOG(R)File 15:ABI/INFORM(R)

00068413 78-02709
Scheduling Boats to Sample Oil Wells in Lake Maracaibo
Cunto, Elio
Operations Research v26n1 PP: 183-199 Jan./Feb. 1978
ISSN: 0030-364X JRNL CODE: OPR
AVAILABILITY: Photocopy available from ABI/INFORM 15117.00

ABSTRACT: Sampling oil wells is a routine operation that involves withdrawing a fraction of the liquid flowing from the well, an operation not performed at **fixed** intervals. Lagoven S. A. operates 3000 oil wells in Lake Maracaibo, Venezuela, with production capacity of one million barrels a day. A computer system determines which of these wells require a sample and also schedules routes for the launches that visit the selected wells. The launch-**scheduling** algorithm is a **heuristic** that schedules up to 400 points in several routes, each having up to 106 points. The algorithm solves a special case of the vehicle dispatch problem, where the **constraints** for using the launches are their traveling times and the number of points on their routes. The impact of the system on field operations has...

6/3,K/50 (Item 1 from file: 148)
DIALOG(R)File 148:IAC Trade & Industry Database

05676840 SUPPLIER NUMBER: 12838637
The capacity expansion problem in the service industry with multiple resource constraints.

Ganz, Zvi; Berman, Oded
Socio-Economic Planning Sciences, v26, n1, p1(15)
Jan, 1992
ISSN: 0038-0121 LANGUAGE: ENGLISH RECORD TYPE: ABSTRACT

ABSTRACT: Algorithmic and **heuristic** models are developed to solve the problem of capacity expansion in services industries with multiple resource **constraints** . One case considered is a **linear programming** problem for service organizations that rent, lease or sub-contract their facilities. The second case considered involves a mixed integer programming problem for services that pay **fixed** costs for any form of capacity expansion.

6/3,K/51 (Item 2 from file: 148)
DIALOG(R)File 148:IAC Trade & Industry Database

05673884 SUPPLIER NUMBER: 13480097
The traveling salesman problem: an overview of exact and approximate algorithms.
Laporte, Gilbert
European Journal of Operational Research, v59, n2, p231(17)
June 10, 1992
ISSN: 0377-2217 LANGUAGE: ENGLISH RECORD TYPE: ABSTRACT

ABSTRACT: Exact and approximate algorithms for the traveling salesman problem (TSP) are presented. These are integer **linear programming** formulations; assignment lower bound and related branch-and-bound algorithms; the shortest spanning arborescence bound; the shortest spanning tree bound; the 2-matching lower bound; **heuristics** with guaranteed worst-case performance; **heuristics** with good empirical performance; composite algorithms; and related algorithms. These algorithms yield solutions to the TSP with over 2000 vertices using **constraint relaxation** algorithms. Tabu search methods and generalized insertion algorithms are also proposed as potentially powerful **heuristics** .

6/3,K/52 (Item 3 from file: 148)
DIALOG(R)File 148:IAC Trade & Industry Database

04020963 SUPPLIER NUMBER: 08224496
A dual-ascent procedure for large-scale uncapacitated network design.
Wong, R.T.; Balakrishnan, A.; Magnanti, T.L.
Operations Research, v37, n5, p716(25)
Sept-Oct, 1989
ISSN: 0030-364X LANGUAGE: ENGLISH RECORD TYPE: ABSTRACT

ABSTRACT: The design problem of the fixed-charged network arises in a number of contexts such as communication, transportation, and **production scheduling** . A variety of dual-ascent algorithms for this problem are proposed which generalize known ascent processes for solving plant location, shortest path, directed spanning tree...

...network problems. Computational findings are developed for several types of test problems with up to 500 integer and 1.98 million on-going variables and **constraints** . These findings suggest that the dual-ascent procedure and a connected drop-add **heuristic** generate solutions that, in nearly all cases, are guaranteed to be between one to four percent of optimality. In addition, the process does not require...

00969797
CONSTRAINTS
Intelligent Software Strategies December 00, 1990 V. 6 NO. 12
ISSN: 0887-221X WORD COUNT: 3239
PUBLISHER: Cutter Information Corp.

...college course schedules. The work was done with MCC's PROTEUS.

Steven Minton, Mark D. Johnson, Andrew B. Philips, and Philip Laird, "Solving Large-Scale **Constraint** Satisfaction and **Scheduling** Problems Using a **Heuristic** **Repair** Method" in Proceedings: Eighth National Conference on AI. (AAAI-90), vol. 1, pp. 17-24. This paper reports the derivation of a **heuristic** from a neural network that scheduled the use of the Hubble Space Telescope.

```
File 751:Datapro Software Directory 1996/Jul
       (c) 1996 McGraw-Hill, Inc.
File 752:Datapro Product Specifications 1996/Jul
         (c) 1996 McGraw-Hill, Inc.
File 256:SoftBase:Reviews,Companies&Prods. 95-1996/Jul
         (c)1996 Info.Sources Inc
File 621:IAC New Prod.Annou.(R) 1985-1996/Sep 10
         (c) 1996 Information Access Co
File 237:Buyer`s Guide to Micro Software(SOFT) 1993/Sep
         (c) 1993 ONLINE Inc.
File 278:Microcomput.Software Guide 1996/Aug
         (c) 1996 Reed Reference Publishing

Set     Items   Description
S1      32744    (MATERIAL?(1W)REQUIREMENT? OR CAPACIT?()RESOURCE? OR FINIT-
             E()CAPACIT? OR PRODUCTION)(2N)(SCHEDUL? OR PLANNING) OR LINEA-
             R(1W)PROGRAM? OR SCHEDULING OR PLANNING
S2       3290    CONSTRAIN?
S3         49    (LOOKAHEAD OR LOOK?()AHEAD OR HEURISTIC? OR ITERAT?) (S) (-
             REPAIR? OR RELAX? OR FIX???)
S4      33374    S1 OR MRP OR CRP OR FCS
S5          1    S4(S)S2(S)S3
S6          3    S4(S)S2(S)(REPAIR? OR RELAX?)
S7          3    S6 OR S5
S8          3    S7 NOT (PY=>1995 OR RY=>1995)
```

?t s8/7/all

8/7/1 (Item 1 from file: 256)
DIALOG(R)File 256:SoftBase:Reviews,Companies&Prods.

01498467 DOCUMENT TYPE: Product

PRODUCT NAME: RSM - A Resupply Scheduler Using Integer Optimization (498467)

COSMIC (084298)
Univ of Georgia 382 E Broad St
Athens, GA 30602-4272 United States
TELEPHONE: (706) 542-3265

RECORD TYPE: Directory

CONTACT: Tim Peacock, Dir

RSM, Resupply **Scheduling** Modeler, is a fully menu-driven program that uses integer programming techniques to determine an optimum schedule for replacing components on or before the end of a **fixed** replacement period. Although written to analyze the electrical power system on the Space Station Freedom, RSM is quite general and can be used to model the resupply of almost any syste subject to user-defined resource **constraints** . RSM is based on a specific form of the general **linear programming** problem in which all variables in the objective function and all variables in the **constraints** are integers. While more computationally intensive, integer programming was required for accuracy when modeling systems with small quantities of components. Input values for component life cane be real numbers, RSM converts them to integers by dividing the lifetime by the period duration, then reducing the result to the next lowest integer. For each component, there is a set of **constraints** that insure that it is replaced befor its lifetime expires. RSM includes user-defined **constraints** such as transportation mass and volume limits, as well as component life, available **repair** crew time and assembly sequences. A weighting factor allows the program to minimize factors such as cost. The program then performs an **iterative** analysis, which is displayed during the processing. A message gives the first period in which resources are being exceeded on each **iteration** . If the **scheduling** problem is unfeasible, the final message will also indicate the first period in which resources were exceeded. RSM is written in APL2 for IBM PC series computers and compatibles. A stand-alone executable version of RSM is provided; however, this is a 'packed' version of RSM which can only utilize the memory within the 640K DOS limit. This executable requires at least 640K of memory and DOS 3.1 or higher. Sourc code for an APL2/PC workspace version is also provided. This version of RSM can make full use of any installed extended memory but must be run with the APL2 interpreter; and it requires an 80486 based microcomputer or an 80386 based microcomputer with an 80387 math coprocessor, at least 2Mb of extended memory, and DOS 3.3 or higher. The standard distribution medium for this package is one 5.25 inch 360K MS-DOS format diskette. RSM was developed in 1991. APL2 and IBM PC are registered trademarks of International Business Machines Corporation. MS-DOS is a registered trademark of Microsoft Corporation.

REVISION DATE: 950822

8/7/2 (Item 2 from file: 256)

01497908 DOCUMENT TYPE: Product

PRODUCT NAME: ACARA - Availability, Cost & Resource Allocation (497908)

COSMIC (084298)
Univ of Georgia 382 E Broad St
Athens, GA 30602-4272 United States
TELEPHONE: (706) 542-3265

RECORD TYPE: Directory

CONTACT: Tim Peacock, Dir

ACARA is a program for analyzing availability, lifecycle cost, and resource **scheduling** . It uses a statistical Monte Carlo method to simulate a system's capacity states as well as component failure and **repair** . Component failures are modelled using a combination of exponential and Weibull probability distributions. ACARA schedules component replacement to achieve optimum syste performance. The **scheduling** will comply with any **constraints** on component production, resupply vehicle capacity, on-site spares, or crew manpower and equipment. ACARA is capable of many types of analyses and trade studies because of its integrated approach. It characterizes the system performance in terms of both state availability and equivalent availability (a weighted average of state availability). It can determine the probability of exceeding a capacity state to assess reliability and loss of load probability. It can also evaluat the effect of resource **constraints** on system availability and lifecycle cost. ACARA interprets the results of a simulation and displays tables and charts for: (1) performance, i.e., availability and reliability of capacity states, (2) frequency of failure and **repair** , (3) lifecycle cost, including hardware, transportation, and maintenance, and (4) usage of available resources, including mass, volume, and maintenance man-hours. ACARA incorporates a user-friendly, menu-driven interface with full screen data entry. It provides a file management system to store and retrieve input and output datasets for system simulation scenarios. ACARA is written in APL2 using the APL2 interpreter for IBM PC compatible systems running MS-DOS. Hardware requirements for the APL2 system include 640 of RAM, 2Mb of extended memory, and an 80386 or 80486 processor with an 80x87 math co-processor. A dot matrix printer is required if the user wishes to print a graph from a results table. A sample MS-DOS executable is provided on the distribution medium.

REVISION DATE: 950822

8/7/3 (Item 1 from file: 621)

0288824
News Release
DATELINE: Charleston, SC January 15, 1991 WORD COUNT: 726

Life Cycle Engineering Inc
1 Poston Road, Suite 300
PO Box 300001

Charleston, SC 29417-3000
803/556-7110
TLX: 755698

contact: Penny L. Thompson
LCE, Inc
803-556-7110

Life Cycle Engineering Introduces Maintenance Management Software

Software package designed to help professional maintenance engineers manage preventive and corrective maintenance program incorporates consulting engineering firms's fifteen years of experience

Charleston, SC January 15, 1991 Life Cycle Engineering, Inc. (LCE) today announced availability of its ORION integrated management package for professional engineers involved with computer aided maintenance management. ORION speeds the development of comprehensive maintenance programs, monitors maintenance costs and schedules, and provides detailed management and financial reports. Designed to rvn on IBM PC and compatible machines, the software package incorporates LCE' s fifteen years of experience in designing, installing, and operating manual and automated maintenance programs in numerous production and manufacturing facilities. ORION is targeted at maintenance engineers in federal, state, and municipal agencies, as well as at organii:ations with large investments in complex plants and equipment such as hospitals, utilities, puip and paper mills, oil drilling companies, and defense contractors.

"Maintenance used to be regarded as a necessary evil: the department that fixed things when they broke," according to Benson Bums, program manager at Life Cycle Engineering. "Now, enlightened managers realize that their company's success depends to a great extent on a maintenance program that strives to have equipment operating at peak efficiency 100% of the time. As companies attempt to gain a competitive edge in world markets, the role of maintenance is becoming increasingly critical. Nationwide, billions of dollars are spent annually on construction and equipment for expanding industrial facilities and capabilities. Industries are looking today to computer aided maintenance management for cost cutting, reliability improvements, and increased productivity."

ORION's primary purpose is to manage a comprehensive maintenance plan and to help management monitor the costs, performance, and effectiveness of the maintenance plan. ORION provides the maintenance organization with three major benefits: reduced maintenance costs, better management of resources, and increased production due to increased uptime. With ORION, scheduling of maintenance downtime is optimized around parts and labor availability as well as schedule constraints, thereby minimizing inventory and labor costs. With fewer emergency repairs, there are fewer interruptions to the planned production schedule and fewer high cost parts emergencies. Planned downtimes help factory management avoid unscheduled delays and stick to optimized work schedules.

ORION is also easy to use. ORION guides the user in scheduling maintenance procedures and assigning maintenance requirements to individual pieces of equipment. Management tasks are aided by the software's ability to provide automatic tracking of equipment and problems and by its financial reporting capabilities. Input and

output forms and data follow industry norms in the maintenance field. Professional maintenance people will be instantly familiar with the software's nomenclature and reporting formats.

Maintenance procedures are assigned frequencies, labor costs, parts costs, etc. Routine scheduled maintenance, corrective maintenance, emergency repairs, deferred or unperformed maintenance, or regulatory-required maintenance are all tracked and recorded by ORION with ease. The software provides full work order generation plus complete inventory control and purchasing of spare parts. ORION generates a running total of maintenance costs to be kept for future analysis and can output over forty standard reports.

ORION will support a maintenance program for virtually any size plant. The ORION software, a personal computer, and a 20MB hard disk are sufficient to track up to 20,000 independent maintenance actions.

ORION is available 10 days ARO. List price for the single user DOS version is $4,995 and includes six months of telephone support. The software is designed to support remote log-on by LCE experts who can provide support, custom software enhancements, and/or advice on maintenance problems. A multi-user LAN-based package is available starting at $8,500.

Life Cycle Engineering, Inc is a professional consulting engineering firm specializing in maintenance engineering and planned maintenance programs. LCE was a pioneer in the development of predictive maintenance techniques and equipment monitoring procedures for defense applications. With a permanent staff of over 250 maintenance engineers and technicians, LCE provides a wide range of maintenance services to its customers, including maintenance and repair work, logistics support, program management, and full documentation. LCE also provides custom engineered support plans for both specialized customer equipment and technical programs.

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File 322:Polymer Online
         (c) 1990 John Wiley & Sons Inc.
File 323:RAPRA Rubber & Plastics 1972-1996/Sep B2
         (c) 1996 RAPRA Technol Ltd
File 335:Ceramic Abstracts 1976-1995/Dec Q4
         (c) 1996 American Ceramic Society

Set     Items   Description
S1     827737   (MATERIAL?(1W)REQUIREMENT? OR CAPACIT?()RESOURCE? OR FINIT-
             E()CAPACIT? OR PRODUCTION)(2N)(SCHEDUL? OR PLANNING) OR LINEA-
             R(1W)PROGRAM? OR SCHEDULING OR PLANNING
S2     464551   CONSTRAIN?
S3      23227   (LOOKAHEAD OR LOOK?()AHEAD OR HEURISTIC? OR ITERAT?) AND -
             (REPAIR? OR RELAX? OR FIX???)
S4        940   S1 AND S2 AND S3
S5      97638   (MATERIAL?(1W)REQUIREMENT? OR CAPACIT?()RESOURCE? OR FINIT-
             E()CAPACIT? OR PRODUCTION)(2N)(SCHEDUL? OR PLANNING) OR LINEA-
             R(1W)PROGRAM?
S6        451   S5 AND S2 AND S3
S7          6   S6 AND (SCORE? OR SCORING OR RANK???)
S8         12   S4 AND (SCORE? OR SCORING OR RANK???)
S9         10   S8 NOT (PY=>1995 OR CY=>1995 OR PD=>941011)
```

?t s9/7/all

9/7/1 (Item 1 from file: 8)
DIALOG(R)File 8:Ei Compendex(R)

03478815 E.I. Monthly No: EI9209115313
Title: Optimal algorithm for the orienteering tour problem.
Author: Ramesh, R.; Yoon, Yong-Seok; Karwan, Mark, H.
Corporate Source: State Univ of New York at Buffalo, Buffalo, NY, USA
Source: ORSA Journal on Computing v 4 n 2 Spring 1992 p 155-164
Publication Year: 1992
CODEN: OJCOE3 ISSN: 0899-1499
Language: English
Document Type: JA; (Journal Article) Treatment: A; (Applications); T; (Theoretical)
Journal Announcement: 9209
Abstract: Orienteering is a sport in which a competitor selects a path from a start to a destination, visiting control points along the path. Each control point has an associated **score** , and the travel between control points involves a certain cost. The problem is to select a set of control points to visit, so that the total **score** is maximized subject to a budget **constraint** on total cost. Several versions of this problem exist. In the version considered in this research, the start and the destination are the same, and the problem is to construct a subtour of the set of control points. The orienteering problem is a variant of the traveling salesman problem, and arises in vehicle routing and **production scheduling** situations. This problem has been shown to be NP-hard in the literature. We develop an optimal algorithm to solve this problem, using Lagrangean **relaxation** within a branch-and-bound framework. The Lagrangean **relaxation** is solved by a degree-**constrained** spanning tree procedure. Characteristics of the Lagrangean **relaxation** are studied, and several implementation features to improve the performance of the algorithm are presented. Detailed computational results for problems having up to 150 control points are presented. The results show that the proposed approach is viable for solving problems of medium to large size. (Author abstract)

9/7/2 (Item 1 from file: 239)
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16089221 MR 95d#90001
Interior point approach to linear, quadratic and convex programming.
Algorithms and complexity.
den Hertog, D. (Center for Quantitative Methods, Philips Research Laboratory, 5600 MD Eindhoven, The Netherlands)
Corporate Source Codes: NL-PRL-QM
Publ: Kluwer Academic Publishers Group, Dordrecht, 1994, xii+208 pp. ISBN: 0-7923-2734-9
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Abstract Length: LONG (133 lines)
The pioneering paper of Karmarkar, in 1984, initiated an immense amount of research in the field of interior point methods for linear and nonlinear programming. According to a rough estimate, since then more than 2000

papers on the subject have been published. The many variants of the original algorithm (and their extensions to the nonlinear case) are divided by the author into four categories: path-following methods, affine scaling methods, projective potential-reduction methods and affine potential-reduction methods.

In his book the author presents a coherent and unifying description and analysis of path-following methods for linear and nonlinear convex programming problems. He makes clear that these methods are based on classical concepts: the logarithmic barrier method of Frisch (1955), Fiacco and McCormick (1968) and the center method of Huard (1968). Both methods parametrize the so-called central path of the problem and follow this path approximately to the set of optimal solutions. They differ only in the choice of the parameter.

Most of the path-following methods in the existing literature, which are shown to be polynomial, were based on small updates of the parameter and on taking small steps of **fixed** length (without line searches). Such ``short-step'' methods, which follow the central path very closely, require many **iterations** and therefore are less attractive from the practical point of view. The author not only analyses ``short-step'' methods, but also ``medium-'' and ``large-step'' path-following methods which use larger updates of the parameter and line searches. In the literature such medium- and large-step path-following methods were only considered for logarithmic barrier methods for the linear case.

The author first proves some important properties of the logarithmic barrier method for LP. In a clever way he uses the fact that the Newton process, in a suitably defined neighborhood of a point of the central path, quadratically converges to this point. Using these properties he derives **iteration** bounds for finding an ϵ-optimal solution: $O(n \ln n \mu\sb 0/\epsilon)$ Newton **iterations** for the long-step variant, and $O(\sqrt{n} \ln n \mu\sb 0/\epsilon)$ for the medium- and short-step variants. Here n is the number of inequality **constraints** and $\mu\sb 0$ the initial value of the barrier parameter.

Next the author considers the case of convex quadratic programming. Just as in the linear case he uses the length of the Newton step, in terms of the (local) metric determined by the Hessian of the logarithmic barrier function, as a measure for proximity to the current reference point on the central path. The structure of the analysis is exactly the same as for the linear case, and the obtained **iteration** bounds are also the same.

He proceeds by extending the approach to more general convex programming problems. For that goal he makes use of a smoothness condition introduced by Nesterov and Nemirovsky in 1989, namely ``self-concordance'' of the logarithmic barrier function of the problem. This notion uses the ``self-concordance parameter'' κ which measures ``smoothness'' of the problem. One has $\kappa=1$ in the linear and the quadratic case. He then derives **iteration** bounds which are compatible with the above bounds, namely $O(\kappa\sp 2 n \ln n \mu\sb 0/\epsilon)$ Newton **iterations** for the long-step, and $O(\kappa \sqrt{n} \ln n \mu\sb 0/\epsilon)$ **iterations** for the medium- and short-step methods. In the long-step case this considerably improves the bound obtained by Nesterov and Nemirovsky.

Nesterov and Nemirovsky proved that the following classes of problems satisfy the self-concordance condition: linear and convex quadratic programming (with quadratic **constraints**), primal geometric programming, $l\sb p$-approximation problems, minimizing of matrix norms, and finding of the maximal volume inscribed ellipsoid in a polytope. An important result of the thesis is that the author extended this list with (generalized) entropy programming, dual geometric programming and primal and dual $l\sb p$-programming. These results are proved in Appendix A. The author also makes clear that the value of the self-concordance parameter κ sometimes can be decreased by reformulating the problem.

After dealing extensively with the logarithmic barrier method (in

Chapter 2), in Chapter 3 the author concentrates on the center method of Huard. He shows that there is a close relationship between the two approaches, and by exploring this the analysis of the center method becomes relatively simple, and gets the same structure as for the the logarithmic barrier approach. Also, the **iteration** bounds (for finding an ϵ-optimal solution) are in essence the same as for the logarithmic barrier approach. This is true for the linear, the convex quadratic, and the general convex programming case.

In Chapter 4 the author discusses two ways to reduce the amount of work per **iteration** . The established relationship between the logarithmic barrier and the center method is used to justify that he restrict himself to the first of the two methods, since the required modifications for the second method are straightforward. In each **iteration** of the logarithmic barrier method the search direction is calculated by solving a system of linear equations. The coefficient matrix of this system depends on the current **iterate** . Per **iteration** this requires $O(n\sp 3)$ arithmetical operations. First he discusses the use of approximations of the **iterates** in the calculation of the search direction. Then the subsequent search directions can be obtained by using so-called **rank** -one modifications, as already introduced by Karmarkar. This leads to a reduction of the amount of work per **iteration** with a factor $\sqrt{n}$. The second approach reduces the amount of work per **iteration** by using only an appropriate subset of the **constraints** . In this approach **constraints** are added and deleted to the (changing) subset, according to the closeness to the **iterate** . Again, upper bounds for the number of **iterations** are derived, and these bounds are comparable with the bounds for the usual logarithmic barrier method, except that the parameter n in these bounds is replaced by $q\sp *$, where $q\sp *$ denotes the maximal number of **constraints** in the subset.

Finally, in Chapter 5, the relation of path-following methods and other interior point methods is discussed. It turns out that the other methods can easily be described in terms of the derived theory. The basic idea in all methods is to point at some reference point on the central path, and to find a suitable approximation of this point by Newton's method. Then the reference point is updated until the **iterates** are close enough to the optimal solution set. The explicit calculation of the search direction used in all of these methods (in the linear case) yields the surprising result that the search direction is always a linear combination of the so-called affine scaling direction and the centering direction. The **iteration** bounds, obtained in the thesis for path-following methods, are in the linear case comparable with the **iteration** bounds for the other interior point methods. Among the interior point methods the path-following methods are most suitable for generalization to the convex case, e.g., the **iteration** bounds in the literature on potential reduction methods for convex programming are worse than the corresponding bounds for path-following methods.

Nowadays it is known that several implementations of interior point methods for **linear programming** give significant accelerations with respect to the simplex method. Since his thesis makes clear that from the theoretical point of view there is no big difference between the linear and the convex case, the author expects that the design of efficient implementations of path-following methods for convex programming will yield considerable improvements in performance with respect to the existing codes for convex programming.

Reviewer: Terlaky, Tamas (NL-DELF)
Review Type: Signed review

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Optimization. Vol. 1, 2.

Techniques and applications. Proceedings of the International Conference (ICOTA) held in Singapore, June 3--5, 1992. Edited by K. H. Phua [Paul Kang Hoh Phua], C. M. Wang, W. Y. Yeong et al.

Contributors: Phua, K. H.; Wang, C. M.; Yeong, W. Y.; et al.

Publ: World Scientific Publishing Co., Inc., River Edge, NJ, 1992, Vol. 1: xiv+609 pp.; Vol. 2: pp. i--xii and 611--1232. ISBN: 981-02-1062-0

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Optimization,; Conference: Optimization Techniques and Applications,; Singapore, Vol. 1, 2 International, ICOTA 1992

Subfile: MR (Mathematical Reviews) AMS

Abstract Length: LONG (142 lines)

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{Some of the papers are being reviewed individually.}

Reviewer: Editors

Review Type: Table of contents

9/7/4 (Item 3 from file: 239)

DIALOG(R)File 239:MathSci(R)

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Proceedings of the 28th IEEE Conference on Decision and Control. Vol. 1--3.

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Publ: Institute of Electrical and Electronics Engineers, Inc. (IEEE), New York,

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Abstract Length: LONG (419 lines)

The six hundred and sixteen papers in this collection include the following:\ Joseph A. Ball and Israel Gohberg, Cascade decompositions of linear systems in terms of realizations (pp. 2--10); H. Lev-Ari, Lossless cascade networks and stochastic estimation (pp. 17--22); Michael P. Polis, Andrzej W. Olbrot and Minyue Fu, An overview of recent results on the parametric approach to robust stability (pp. 23--29); L. Qiu and E. J. Davison, A unified approach for the stability robustness of polynomials in a convex set (pp. 30--36); H. Chapellat, S. P. Bhattacharyya [Shankar Prashad Bhattacharyya] and M.\ Dahleh [Mohammed A. Dahleh], On the robust stability of a family of disk polynomials (pp. 37--42); M. Mansour [Mohamed Mansour], Robust stability of interval matrices (pp.\ 46--51); Efthimios Kappos, A geometrical linearization theory (pp. 77--81); F. Esfandiari and H. K. Khalil, Observer-based control of fully-linearizable nonlinear systems (pp. 84--89); S.-T. Chung and J. W. Grizzle, Observer error linearization for sampled-data systems (pp. 90--95); Guan Rong Chen and Rui J. P. de Figueiredo, A G-RKHS of bounded nonlinear operators for nonlinear systems control (pp. 96--101).

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Some of the papers are being reviewed individually.

Reviewer: Editors

Review Type: Table of contents

9/7/5 (Item 4 from file: 239)

02957725 MR 87c#90121

Analytical planning.

The organization of systems.

Saaty, Thomas L. (Graduate School of Business, University of Pittsburgh, Pittsburgh, 15260, Pennsylvania)

Kearns, Kevin P. (Department of Mathematics, Carnegie-Mellon University, Pittsburgh, 15213, Pennsylvania)

Corporate Source Codes: 1-PITT-B; 1-CMU

Publ: Pergamon Press, Oxford-Elmsford, N.Y., 1985, viii+208 pp. ISBN: 0-08-032599-8

Series: International Series in Modern Applied Mathematics and Computer Science, 7.

Price: $40.00.

Language: English

Document Type: Book

Journal Announcement: 1804

Subfile: MR (Mathematical Reviews) AMS

Abstract Length: LONG (60 lines)

This compact, rich book was written by a mathematician and by a planner. Intended for students and researchers concerned with **planning** , it could also serve as an introductory text. The greatest value of this work is that it brings together in a very succinct and coherent way current concepts and methods of systems theory as developed by Bertalanffy and many others, and of strategic **planning** . To two of the major philosophies of **planning** , namely formal **planning** and incremental **planning** , the authors add a third: systemic **planning** . Formal **planning** employs quantitative models and optimization methods. Incremental **planning** uses qualitative reasoning to make small changes and it relies on political bargaining to reach consensus. The latter is viewed as the antithesis to the former. The synthesis of these two philosophies is systemic **planning** , which seeks to promote effective interaction with the environment while acknowledging the uncertainties associated with turbulence.

Planning is defined as a ``thinking and social process of aligning what is deduced to be the likely outcome of a situation, given current actions, policies, and environmental forces, with what is perceived as a desirable outcome which requires new actions and policies''. Alignment refers to narrowing the gap between a probable and a desired future, and suggests: (1) projecting the likely future, (2) finding a path to a desired future, and (3) **iterating** these forward and backward processes.

What is both new in the context of **planning** and useful in the book is the pervasive appearance of the ``analytic hierarchy process'' (AHP) that has been developed by Saaty and used in a variety of complex **planning** situations for over a decade. AHP is applied to the three activities generic to any **planning** process: (1) problem structuring, where it is claimed to capture the range of possible perceptions; (2) identification and evaluation of alternatives, where it **relaxes** **constraints** on the range of alternatives and uses a mix of qualitative and quantitative methods to identify and **rank** criteria for selecting a plan; (3) implementation of the chosen responses, where it stresses plan modification to adapt to users' needs.

The AHP is extremely simple. Used, for example, to decide which of m houses to buy according to n criteria, such as size, location, etc., the decision-maker first makes entries into an $n\times n$ matrix that reflect subjective judgments about the importance of each criterion relative to every other one; a scale involving only the numbers 1--9 and their reciprocals is recommended for this purpose. Next, n $m\times m$ matrices of the same kind are formed to express the superiority of each house relative to every other house on each criterion. The priorities are then combined by simple numerical operations involving eigenvalues.

The AHP is discussed in relation to other methods of systemic **planning** , such as Delphi, ``strategic assumption surfacing and testing'', ``the symmetrical linkage system'', ``multiattribute utility theory'', and is held to complement or improve upon them. The book is as much about the AHP as it is about **planning** . It claims to join theories of systems and **planning** . It also offers methods incorporating the best of formal, incremental and systemic **planning** . Finally, it suggests useful ways of improving benefit/cost analyses and resource allocation.

Readers should not expect contributions to mathematics or the application of advanced mathematics. Some may, however, be enlightened by the role of mathematical and analytical thinking in **planning** and stimulated to generate and develop ideas for new mathematics.

Reviewer: Kochen, Manfred (Ann Arbor, Mich.)

Review Type: Signed review

9/7/6 (Item 5 from file: 239)

02866903 CR 86020137

A new polynomial-time algorithm for linear programming.

Karmarkar, N. (AT & T Bell Laboratories, Murray Hill, NJ,

Combinatorica

Combinatorica, 1984, 4, 4 373--395

Language: English

Document Type: Journal

Journal Announcement: 2702

Subfile: CR (Computing Reviews) ACM

Abstract Length: long (85 lines)

This paper describes a remarkable new polynomial algorithm for **linear programming** which has already elicited considerable publicity in the popular press, as well as among the operations research and computer science research communities, because of the striking claims made for its performance. Karmarkar has reported solving several large-scale problems by a factor of 50 times or more faster than those achieved by the simplex method, a practically very efficient (although exponential in the worst case) algorithm devised by Dantzig in 1947 [1]. I will comment further on computational issues below.

In its basic form, Karmarkar's algorithm applies to problems in the form: minimize c$\sp{T}$x subject to\it A \rm x=0, $\Sigma x\sb{j}$=1 and x$\ge $0, where it is assumed that\it A\rm has full row **rank** , that a strictly positive feasible vector x$\sp{0}$is known, and that the minimum value is zero. In this case, the algorithm generates a sequence of strictly positive feasible vectors whose objective function values decrease by a constant factor every\it n\rm **iterations** , where\it n\rm is the number of variables. This provides the polynomial time bound by rounding, as in the analysis by Gr\"otschel, Lov \'asz, and Schrijver [2] of the ellipsoid method. The latter algorithm, originally developed for convex programming by Yudin and Nemirovski in the Soviet Union based on work by Shor, was shown to provide a polynomial algorithm for **linear programming** by Khachian in 1979 (see, e.g., [3]). There is a fascinating relationship between these two algorithms: while based on very different ideas, both generate a sequence of ellipsoids (in the ellipsoid algorithm containing, and in Karmarkar's method contained in, the feasible region), with each **iteration** implicitly solving a weighted least squares problem; both are intrinsically infinite **iterative** methods, though each can be truncated in a polynomial number of steps with relational data; and both use ideas of nonlinear programming more heavily than those of **linear programming** . The contrast in their significance is also noteworthy. The ellipsoid method appears not to be computationally efficient, but has been used theoretically by Gr\"otschel et al. [2] and others to prove that in a certain sense optimization is equivalent to separation, and thus establish the computational complexity of several combinatorial optimization problems. On the other hand, Karmarkar's algorithm, with its considerable computational promise, is apparently unable to provide such theoretical results since it cannot deal with an exponential number of implicit **constraints** .

The ideas introduced by Karmarkar are also novel. He uses projective transformations to view each **iteration** as similar to the first (the ellipsoid method uses affine transformations analogously). The performance guarantee is provided by an auxiliary objective function, Karmarkar's potential function, which decreases by a constant at every **iteration** . The form of this function is reminiscent of logarithmic barrier functions in nonlinear programming.

If one can solve in polynomial time **linear programming** problems in the canonical form above, one can similarly solve general problems. However, the transformation described by Karmarkar in Section 5 has a small gap, in that the transformed problem might have an optimal solution with

the extra homogenizing variable x$
{\prime} \sb{n+1}$=0. In this case, the projective transformation cannot be inverted, or leads to a point at infinity. This could occur, for instance, if the original problem were: minimize x$\sb{1}-$x$\sb{2}$subject to x$\sb{1}-$x$\sb{2} \ge b\sb{1}$, $-$x$\sb{1}$+x$\sb{2}\ge b\sb{2}$, x$ \sb{1}$, x$\sb{2}\ge $0. The resulting canonical problem has an optimal solution x$
{\prime}$=(1/2,1/2,0,...,0)$ \sp{T}$, with corresponding ``point at infinity'' x$ \sb{1}$=x$\sb{2}$=$\infty $, y=u=v=0, $\lambda $=0. Note that the original problem could have an optimal solution or be infeasible according to whether b$\sb{1}$+b$\sb{2}$is nonpositive or positive respectively. I believe the problem can be **fixed** by perturbing b and c, but at a cost of an increased complexity bound.

Finally, let me comment briefly on computational experience. A number of researchers have confirmed the very small number of **iterations** required by Karmarkar's algorithm (growing very slowly with n, if at all; indeed it seems that 30 **iterations** almost always suffice). However, at present only Karmarkar has been able to perform each **iteration** (basically a weighted least squares problem) fast enough to provide dramatic speedups compared to the simplex method.

Reviewer: Michael Todd Ithaca, NY

Review Type: Signed Review

Cited References: [1]DANTZIG, G. B.Linear programming and extensions, Princeton University Press, Princeton, NJ, 1963. SeeCR5, 2 (March-April 1964), Rev. 5434. [2]GR"OTSCHEL, M.; LOV'ASZ, L.; AND SCHRIJVER, A. The ellipsoid method and its consequences in combinatorial optimization, Combinatorica1 (1981), 169--197. [3]BLAND, R. G.; GOLDFARB, D.; AND TODD, M. J. The ellipsoid method: a survey, Oper. Res.29 (1981), 1039--1091.

9/7/7 (Item 6 from file: 239)

02532019 MR 81j#68006

Conference Proceedings of the Twelfth Annual ACM Symposium on Theory of Computing.

Papers presented at the Symposium held in Los Angeles, Calif., April 18--30, 1980.

Publ: Association for Computing Machinery (ACM), New York, 1980, v+447 pp. ISBN: 0-89791-017-6
Price: $17.00.
Language: English
Document Type: Book; Proceedings
Journal Announcement: 1308
Proceedings: Annual ACM Symposium on Theory of Computing,; ACM Symposium: Theory of Computing,; Computing; Los Angeles, Calif., 12th 12th Annual 1980
Subfile: MR (Mathematical Reviews) AMS
Abstract Length: LONG (102 lines)

The eleventh symposium has been reviewed (MR 81a:68004).)
From the foreword: ''The papers in this Proceedings were selected on January 4, 1980, at a meeting of the full program committee from among 125 extended abstracts submitted in response to the call for papers. In an attempt to experiment with the symposium format and respond to the growth in the field, the committee accepted a record forty-seven papers for presentation at this year's symposium and extended the meeting to three full days. Selection was based on originality and relevance to the theory of computing. The papers in these Proceedings were not formally refereed, and papers generally represent preliminary reports of continuing

research. It is anticipated that most of these papers will appear in more polished and complete form in scientific journals.'' Contents. Foreword (p. i); Organizing committee (p. ii). Session I: Albert R. Meyer and Rohit Parikh, Definability in dynamic logic (pp. 1 - 7); John H. Reif, Logics for probabilistic programming (extended abstract) (pp. 8 - 13); Grazyna Mirkowska, Complete axiomatization of algorithmic properties of program schemes with bounded nondeterministic interpretations (pp. 14 - 21); V. R. Pratt, Dynamic algebras and the nature of induction (pp. 22 - 28); Esko Ukkonen, A decision method for the equivalence of some non-real-time deterministic pushdown automata (pp. 29 - 38); David A. Plaisted, On the distribution of independent formulae of number theory (pp. 39 - 44); Richard A. DeMillo and Richard J. Lipton, The consistency of ''P=NP'' and related problems with fragments of number theory (pp. 45 - 57); Deborah Joseph and Paul Young, Independence results in computer science? (preliminary version) (pp. 58 - 69). Session II: Nancy A. Lynch, Fast allocation of nearby resources in a distributed system (pp. 70 - 81); Dana Angluin, Local and global properties in networks of processors (extended abstract) (pp. 82 - 93); Sam Toueg, Deadlock- and livelock-free packet switching networks (pp. 94 - 99); Donna J. Brown, Kraft storage and access for list implementations (extended abstract) (pp. 100 - 107); H. R. Strong, Vector execution on flow graphs (extended abstract) (pp. 108 - 116); Fereidoon Sadri and Jeffrey D. Ullman, A complete axiomatization for a large class of dependencies in relational databases (pp. 117 - 122); Ronald Fagin, Horn clauses and database dependencies (extended abstract) (pp. 123 - 134). Session III: Mark H. Overmars and Jan van Leeuwen, Dynamically maintaining configurations in the plane (detailed abstract) (pp. 135 - 145); Bernard Chazelle and David P. Dobkin, Detection is easier than computation (extended abstract) (pp. 146 - 153); Leo J. Guibas and F. Frances Yao, On translating a set of rectangles (pp. 154 - 160); Martin Tompa, An optimal solution to a wire-routing problem (preliminary version) (pp. 161 - 176); Michael J. Fischer and Michael S. Paterson, Optimal tree layout (preliminary version) (pp. 177 - 189); R. P. Brent and H. T. Kung, The chip complexity of binary arithmetic (pp. 190 - 200); James A. Storer, The node cost measure for embedding graphs on the planar grid (extended abstract) (pp. 201 - 210); Allen Cypher, An approach to the k paths problem (pp. 211 - 217). Session IV: David Lichtenstein, Isomorphism for graphs embeddable on the projective plane (pp. 218 - 224); Gary Miller, Isomorphism testing for graphs of bounded genus (pp. 225 - 235); I. S. Filotti and Jack N. Mayer, A polynomial-time algorithm for determining the isomorphism of graphs of **fixed** genus (working paper) (pp. 236 - 243); Christoph M. Hoffmann, Testing isomorphism of cone graphs (extended abstract) (pp. 244 - 251); Ravindran Kannan and Richard J. Lipton, The orbit problem is decidable (pp. 252 - 261); J. Heintz and C. P. Schnorr, Testing polynomials which are easy to compute (extended abstract) (pp. 262 - 272); Oscar H. Ibarra and Brian S. Leininger, The complexity of the equivalence problem for straight-line programs (pp. 273 - 280); Hartmut Ehrig and Bernd Mahr, Complexity of implementations on the level of algebraic specifications (pp. 281 - 293). Session V: A. Borodin and S. Cook, A time-space tradeoff for sorting on a general sequential model of computation (pp. 294 - 301); Richard M. Karp and Richard J. Lipton, Some connections between nonuniform and uniform complexity classes (pp. 302 - 308); Jia Wei Hong, On some deterministic space complexity problems (pp. 310 - 317); C. K. Yap, Space-time tradeoffs and first order problems in a model of programs (pp. 318 - 325); David A. Carlson and John E. Savage, Graph pebbling with many free pebbles can be difficult (pp. 326 - 332); Martin Tompa, Two familiar transitive closure algorithms which admit no polynomial time, sublinear space implementations (pp. 333 - 338); Joseph Ja'Ja', Time-space tradeoffs for some algebraic problems (pp. 339 - 350); Nicholas

Pippenger, Comparative schematology and pebbling with auxiliary pushdowns (preliminary version) (pp. 351 - 356); Wolfgang J. Paul, Joel I. Seiferas and Janos Simon, An information-theoretic approach to time bounds for on-line computation (preliminary version) (pp. 357 - 367). Session VI: Richard M. Karp and Robert Endre Tarjan, Linear expected-time algorithms for connectivity problems (extended abstract) (pp. 368 - 377); Peter Bloniarz, A shortest-path algorithm with expected time O(n{sup}2 log n log{sup*} n) (pp. 378 - 384); John H. Reif and Paul G. Spirakis, Random matroids (pp. 385 - 397); Kenneth J. Supowit, David A. Plaisted and Edward M. Reingold, **Heuristics** for weighted perfect matching (pp. 398 - 419); Greg N. Frederickson and Donald B. Johnson, Generalized selection and **ranking** (preliminary version) (pp. 420 - 428); F. Frances Yao, Efficient dynamic programming using quadrangle inequalities (pp. 429 - 435); Errol L. Lloyd, Critical path **scheduling** of task systems with resource and processor **constraints** (extended abstract) (pp. 436 - 446); Author index (p. 447). (The papers are not being reviewed individually.)

Reviewer: Editors
Review Type: Table of contents

9/7/8 (Item 1 from file: 35)
DIALOG(R)File 35:Dissertation Abstracts Online

01276476 ORDER NO: AAD93-05018
PARTITIONING AND SCHEDULING **FOR CIRCUIT SIMULATION**
Author: NG, ANTONY PENG-CHEW
Degree: PH.D.
Year: 1992
Corporate Source/Institution: UNIVERSITY OF CALIFORNIA, BERKELEY (0028)
Chair: R. K. BRAYTON
Source: VOLUME 53/10-B OF DISSERTATION ABSTRACTS INTERNATIONAL.
PAGE 5300. 151 PAGES

Electrical simulation of large circuits forms an important step in the verification of large VLSI designs. Circuit sizes have grown by orders of magnitude, and conventional simulators like SPICE (Nag75) have not been able to keep up with this growth. Fortunately, large VLSI circuits have special properties that enable alternative simulation algorithms to handle the size increase somewhat more gracefully. Some of these techniques include selective trace and event-driven simulation, distributed simulation on shared memory machines and waveform **relaxation** .

In this thesis, we present a framework for time-domain transient simulation of large circuits. We assume that the circuit is partitioned into subcircuits and that the subcircuit dependencies can be represented by a directed graph. No assumption is made about the algorithm used to perform the simulation other than the fact that the simulation proceeds in a time incremental fashion.

We describe a **scheduling** framework for coordinating the simulation of the subcircuits. The **scheduling** framework determines the order of evaluation of the subcircuits subject to various temporal **constraints** . In addition, the framework coordinates the communication of information between subcircuits. We show that this framework subsumes most of the popular **scheduling** paradigms like **rank** -ordered simulation, **fixed** -window simulation, and event-driven simulation. We describe a scheduler for this framework that minimizes the amount of memory that is required to store information that is communicated between subcircuits. An extension to this scheduler allows it to schedule on shared memory machines. We also present results of running an implementation of the scheduler on a benchmark suite.

The **scheduling** framework dictates that a feedback arc set be found for the directed subcircuit dependency graph. We present a suite of **heuristic** algorithms for the feedback arc set problem, and will pay particular emphasis to one algorithm, the min-cut algorithm, which formulates the problem in terms of a flow network. We will also present results of running implementations of these algorithms on various benchmarks.

We conclude with some directions for future work.

9/7/9 (Item 2 from file: 35)

865504 ORDER NO: AAD84-27005

DUAL-BASED HEURISTICS **FOR CAPACITY-** CONSTRAINED PRODUCTION SCHEDULING

Author: KARAYEL, MAHMUT NEDIM

Degree: PH.D.
Year: 1984
Corporate Source/Institution: UNIVERSITY OF CALIFORNIA, BERKELEY (0028)
Source: VOLUME 45/09-B OF DISSERTATION ABSTRACTS INTERNATIONAL.
PAGE 3031. 115 PAGES

Dual-based **heuristics** are developed for **scheduling** **production** in multi-stage capacity-**constrained** systems. Detailed pricing mechanisms are used to dynamically allocate the production capacity among activities. The ojbective of the approach taken is to minimize the total cost of the **production** **schedule** . The tradeoffs between the availability of production capacity, the inventory levels, and the frequency of set-ups are considered. It is assumed that the value-added portion of the holding cost is nonnegative for each item, and the demand data are deterministic.

Two main classes of capacity **constraints** are considered. First, the properties of optimal schedules are investigated for the problem of multi-stage lot sizing with preallocated capacity bounds. It is shown that, in an optimal schedule, if there is incoming inventory of an item, then either there is no production of this item or the capacity is fully utilized. An efficient and accurate algorithm is developed for the special single-stage case. For multi-stage problems a decomposition procedure is developed which utilizes the single-stage algorithm. Computational results are reported for both the single and the multi-stage cases.

The second class of **constraints** involves environments in which items compete for limited production capacity. The changeovers are modeled as set-up times that absorb capacity. Set-up costs are assumed to be negligible. The dual formulation of the **linear** **program** based on the {0,1} **relaxation** of set-up variables is utilized to **rank** items according to their holding costs. The holding costs are adjusted to take into account the set-up times and the capacity utilization. It is shown that this procedure is exact when set-up times are negligible.

For both types of situations, the approach employs marginal cost concepts to evaluate the efficiency of different levels of capacity utilization. Each step of the procedure uses an algorithm which **schedules** **production** as late as possible, within the given capacity bounds. The algorithms developed in this thesis can be used to determine efficient **production** **schedules** . They can also support management in testing efficiency of certain capacity-preallocation schemes, and in evaluating **scheduling** policies which favor minimum inventory levels.

9/7/10 (Item 1 from file: 94)

01541146 JICST ACCESSION NUMBER: 92A0286886 FILE SEGMENT: JICST-E

Hybrid-Type Approach for Plant Layout Design with a Constraint-Directed Search and a Mathematical Optimization Technique.

FUJITA KIKUO (1); AKAGI SHINSUKE (1); HASE HIROAKI (2); NAKATOGAWA TETSUNDO (3); TAKEUCHI MAKOTO (3)
(1) Osaka Univ., Faculty of Engineering; (2) Osaka Univ., Graduate School ; (3) Mitsubishi Atomic Power Industries Inc.

Nippon Kikai Gakkai Ronbunshu. C(Transactions of the Japan Society of Mechanical Engineers. C), 1992, VOL.58,NO.547, PAGE.967-974, FIG.9, TBL.3, REF.8
JOURNAL NUMBER: F0045BAL ISSN NO: 0387-5024
UNIVERSAL DECIMAL CLASSIFICATION: 658.2
LANGUAGE: Japanese COUNTRY OF PUBLICATION: Japan
DOCUMENT TYPE: Journal
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MEDIA TYPE: Printed Publication

ABSTRACT: A hybrid-type approach for plant layout design is pressented with a **constraint** -directed search procedure and a mathematical optimization technique. In layout design, a plant must be arranged to satisfy spatial **constraints** imposed by its components. In our approach, the whole space of a plant building is divided into the finite compartments with a modular size in order to separate the description of the layout into the combinational part and the dimensional part. According to this, the approach consists of two steps. In the first step, a **constraint** -directed search procedure is applied for **fixing** the combinational relations among plant components so as to satisfy the spatial layout conditions. In the second step, an optimization technique is applied for determining the actual dimensions of compartments so as to minimize the size of a plant building considering the size of components. In the optimization, mixed-integer programming and sequential **linear programming** are combined and the formulation is carried out automatically from the result of the first step. This hybrid approach has been applied to the design of a nuclear power plant in order to check its validity and effectiveness. (author abst.)

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3/7/1 (Item 1 from file: 2)
DIALOG(R)File 2:INSPEC

4685403 INSPEC Abstract Number: C9407-1290F-053
Title: Scheduling products with bills of materials using an improved Lagrangian relaxation **technique**
Author(s): Czerwinski, C.S.; Luh, P.B.
Author Affiliation: Dept. of Electr. & Syst. Eng., Connecticut Univ., Storrs, CT, USA
Journal: IEEE Transactions on Robotics and Automation vol.10, no.2 p.99-111
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Language: English Document Type: Journal Paper (JP)
Treatment: Theoretical (T)
Abstract: A bill of materials specifies the sequence in which parts are to be processed and assembled in order to manufacture a deliverable product. In practice, a bill of materials may be quite complex, involving hundreds of parts to be processed on a number of limited resources, making scheduling difficult. This has forced many practitioners to turn to Material Requirements Planning (**MRP**) and **heuristic** rules to perform scheduling. These methods are seldom integrated, resulting in unreliable completion times for products and, hence, low customer satisfaction. This paper addresses the issue of integrally scheduling parts that are related through a bill of materials for the purpose of improving the on-time performance of products as well as reducing work-in-process (WIP) inventory. The technique presented here is based on an existing Lagrangian **relaxation** (LR) approach for the scheduling of independent parts in a job shop. An auxiliary problem formulation with a modified subgradient method is adopted to improve the computation time of the existing LR approach. This improved LR approach allows the bill of material **constraints** to be considered directly in the problem formulation. (16 Refs)

3/7/2 (Item 1 from file: 144)
DIALOG(R)File 144:Pascal

09561035 PASCAL No.: 91-0351465
A survey of constraint **based scheduling systems using an artificial intelligence approach**
ATABAKHSH H
National res. council Canada, systems lab., Ottawa ON K1A OR6, Canada
Journal: International journal for artificial intelligence in engineering , 1991, 6 (2) 58-73
ISSN: 0267-9264 CODEN: IAIEEA Availability: CNRS-20985
No. of Refs.: 75 ref.
Document Type: P (Serial) ; A (Analytic)
Country of Publication: United Kingdom
Language: English
Recently,' Artificial Intelligence approaches have been used to solve the problem of **constraint** based scheduling. The aim is to find a feasible solution which satisfies a maximum number of **constraints** within a reasonable amount of time. An AI system in this domain should not replicate the human sheduler but extend his capabilities by doing more problem solving than was manually possible. The **constraints** are used to help

reduce the search space. This paper reviews various AI techniques used in **constraint** based scheduling, by comparing existing systems. The aim is to help future research concerning the application of AI to **constraint** based scheduling, by evaluating the progress that has been made in this area

3/7/3 (Item 1 from file: 35)
DIALOG(R)File 35:Dissertation Abstracts Online

01328863 ORDER NO: AAD94-02573
CONSTRAINT-**BASED CONSTRUCTION PROJECT SCHEDULING**
Author: HUSSAIN, MANSUR BIN
Degree: PH.D.
Year: 1993
Corporate Source/Institution: CARNEGIE-MELLON UNIVERSITY (0041)
ADVISER: CHRIS HENDRICKSON
Source: VOLUME 54/08-B OF DISSERTATION ABSTRACTS INTERNATIONAL.
PAGE 4291. 158 PAGES

This research explored the potential benefit of a more flexible and extensive representation of **constraints** in the construction project scheduling problem. The scheduling problem was formulated and solved as a **Constraint** Satisfaction Problem (CSP) and a subsequent **Constraint Relaxation** Problem (**CRP**). The research demonstrated a mechanism for considering an appropriate level of **constraint** representation to solve the practical construction project scheduling problem. In particular, the experiment demonstrated that this representation can be used as a synthesis tool for a decision support system to solve the problem.

A backtracking scheme was used to solve the CSP problem. In this scheduling formulation, only the conventional **constraints** --resource capacity, activity precedence, activity duration, and project due date--were represented for testing and comparison purposes. Resource and temporal labeling were used to perform consistency checks, and a variable ordering **heuristic** was used to schedule with resource **constraints** represented by the equivalent disjunctive arc model. Experience based on scheduling 110 projects, showed the CSP formulation is a feasible but expensive method to solve the scheduling problem. The variable ordering **heuristic** performed relatively well compared to other **heuristics** . As discovered by many other researchers, the backtracking scheme based on chronological backtracking scheme performed poorly; it often failed to backtrack to the source of failure.

A **relaxation** scheme based on the network flow algorithm was used to solve the **CRP** problem. The procedure uses the initial schedule generated by any conventional scheduling **heuristic** as a basis, including the CSP. A set of critical sequence activities **constrained** by capacity and precedence **constraints** is identified from the current schedule. Then, using an appropriate level of **constraint** representation, together with knowledge on their behavior and relationship, the **constraints** are **relaxed** relative to the activities on the critical sequence. The output of the procedure is a set of feasible values for the **constraint** for each value of project duration, while minimizing additional project cost due to direct cost. The procedure will also determine resource capacity adjustments that need to be made when the scheduling objective cannot be met with the existing resource capacity. The procedure was tested on six projects to determine the cost utility curve for the projects.

3/7/4 (Item 2 from file: 35)
DIALOG(R)File 35:Dissertation Abstracts Online

01251253 ORDER NO: AAD92-35808
ALGORITHMS FOR DYNAMIC MULTI-ITEM, MULTI-PERIOD, LOT-SIZING MODEL WITH MULTIPLE RESOURCES CONSTRAINTS **(INVENTORY SCHEDULING, PRODUCTION MANAGEMENT)**
Author: CHIARNG, DAVID MING-HUARNG
Degree: PH.D.
Year: 1992
Corporate Source/Institution: THE UNIVERSITY OF IOWA (0096)
Supervisor: RAJ JAGANNATHAN
Source: VOLUME 53/07-A OF DISSERTATION ABSTRACTS INTERNATIONAL.
PAGE 2437. 115 PAGES

We address a class of dynamic lot sizing problems with a single-level, multi-item, multi-period, and multiple resources **constraints** . The traditional way to present the problem is to use zero-one mixed integer programming formulation. Due to large number of zero-one variables, the problem becomes computationally intractable to solve by any of the integer programming codes. Thus, we suggest three different approaches to solve the problem.

The first is a rolling schedule approach that is based on the concept of least unit cost **heuristic** . The second is also a rolling schedule approach that considers minimum total cost in each period. The third is a Lagrangean **relaxation** approach that obtains a lower bound first and then applies a **heuristic** to recover a feasible solution. On the basis of these three approaches, different algorithms are developed to solve the problem.

Our computational results show that under different situations, these approaches have their advantages and disadvantages in terms of time consumption and the closeness of the solutions to the Lagrangean **relaxation** lower bound value. In general, the third approach produces the best results among these approaches when there are a large number of items. On the other hand, the first and second approaches will obtain better results if there are few items produced, long planning horizons, and large number of resources **constraints** in each period.

Finally, it is shown that the single end-item **MRP** problem can be reformulated as Capacitated Lot Sizing Problem (CLSP) with multiple resources **constraints** . Thus, the three approaches to solve a CLSP can also be applied to solve a single end-item **MRP** problem. The development of these models should provide new decision making tools for production managers to use for determining a feasible production schedule.

3/7/5 (Item 3 from file: 35)
DIALOG(R)File 35:Dissertation Abstracts Online

0984602 ORDER NO: AAD88-04041
PRODUCTION PLANNING AND SCHEDULING IN A FLEXIBLE MANUFACTURING SYSTEM ENVIRONMENT
Author: GHOSH, SOUMEN
Degree: PH.D
Year: 1987
Corporate Source/Institution: THE OHIO STATE UNIVERSITY (0168)
Source: VOLUME 49/02-A OF DISSERTATION ABSTRACTS INTERNATIONAL.
PAGE 0293. 278 PAGES

In this dissertation research, two decision support models are formulated in which the production scheduling function in a flexible manufacturing system is addressed. Specifically, the decisions addressed by

the models include the break-up of weekly production requirements to daily production requirements, defining the leakage between **MRP** lot sizing and shop order release, the determination of production batch sizes for each operation of each part-type, the determination of inventory and backordering levels, and the daily assignment of each batch to machine groups, subject to the flexibility of alternate routings.

Both the models are formulated as multiproduct, multiperiod, multistage models having an underlying network structure. The large-scale nature of the models, along with the presence of bundle capacity **constraints** defies the straight forward application of any standard solution code. Furthermore, the second of the two models has integer variables. A price-directive decomposition procedure using column generation is used, whereby the overall problem is decomposed into a master problem and several subproblems. The subproblems are shown to have a pure network structure and are efficiently solved using a standard network code. However, since the second formulation is an integer network model, the problem is first linearized by **relaxing** the setup variables. The decomposition technique is then applied to this **relaxed** version as part of a **heuristic** procedure to solve the overall integer model.

Experimentation with varying problem sizes is performed on both models to first determine the computational efficiency of the solution techniques; and second to determine the impact of routing flexibility on factors including total cost, inventory levels, existence of bottlenecks, capacity utilization, throughput time, and the number of occurrences of setups and split lots. Experimental results indicate that while the total system cost, inventory levels, number of bottleneck machines, and throughput times decrease as routing flexibility increases, there is a concurrent increase in the number of setups and split lot production. This clearly indicates that while increase in routing flexibility is desirable for some key shop performance measures, the benefits are not attained without associated costs.